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HOT WATER HEATING NUMBER

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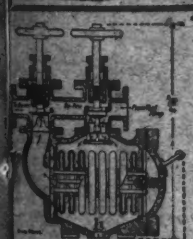

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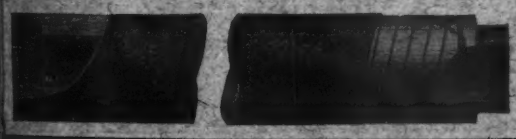

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK FEBRUARY, 1912

Important Points in Gravity Hot Water Heating

BY JOHN JAEGER

Why has the hot water system of heating a comparatively restricted field of application in the eastern part of the country, at least, and why is it not employed more frequently as a heating medium for dwellings and houses of all kinds?

Those who are familiar with the system justly claim that it has many advantages over an ordinary steam heating plant. One of the very strong points is its adaptability to different outside temperatures in varying the temperature of the system as a whole.

Anybody who comes in to a house heated by hot water can feel a certain difference of the heated room in favor of the hot water system. The air seems milder at the same temperature and that peculiar smell of roasted dust, always objectionable in a steam-heated room, is wholly eliminated, as the heated surfaces in a properly managed hot water system should never be so hot as to roast the dust lying on such surfaces.

The first cost of a hot water heating system is greater, compared to a system where steam is used as the heating medium, and this item, of course, counts largely when the decision is made by the owner. The operating cost, however, is decidedly in favor of the hot water system when properly operated. Possibilities of freezing of the system can, when proper care is taken, be wholly obviated and possible flooding of the house is such a rare occurrence that it should not be of any importance when the selection of the system is made.

One unfavorable point of some weight, however, is the performance of a badly-proportioned hot water heating system where the owner is constantly complaining of not getting the necessary heat where or when he wants it. This is a case where a black sheep blackens the whole herd.

It can be stated frankly that most of the designers of hot water systems do not take the painstaking care to proportion the pipe sizes according to good practice and go at it in too crude a manner, using a rule of thumb for the connections and mains. Naturally the results with the system will be affected accordingly. Knowing the theory of the operation of a hot water system one understands at a glance that the engineer who lays out a poorly-proportioned design is naturally to be blamed for the prejudice against the hot water system.

To proportion the piping of a hot water system one has to bear in mind that the gravity action of the water has to be taken as the moving force in the system.

The capacity of a pipe in such a

heating system depends, therefore, on the temperature difference between supply and return water and the perpendicular distance between radiating surface and reheating apparatus.

The accompanying table brings out this point. Assuming the supply temperature of the water to be 185° F. and allowing 36° drop in temperature of the water to 149° we would have an approximate mean temperature of the water of about 170° F. in the radiator.

This temperature difference creates a pressure of about 0.148 in. of water head for each foot of height. If we further assume a distance between the center line of the boiler and the center line of the heating surface at the different floors we obtain the available heads shown in Column 3. Still further assuming the run of the main and connections between boilers and radiators and back again and using for elbows, valves and radiators the equivalent resistance in feet of the pipe we obtain the figures shown in Column 4.

The factor shown in Column 5 is obtained by the available head divided by the maximum single run of equivalent pipe.

Column 6 gives the amount of heating surface in square feet, figured at 170 B. T. U. per square foot, supplied for the corresponding drop in pressure.

The verification of the given amounts can be obtained by reference to any table giving the amount of water supplied through different sized pipes at varying velocities, for to each velocity there is a corresponding frictional head. Column 6 shows very distinctly what a 1 in. pipe, for instance, will do under the assumed conditions. It will supply about 57 sq. ft. on the basement ceiling, on the first floor 70 sq. ft., on the second floor almost double the amount for the first floor or about 130 sq. ft., on the third floor 160 sq. ft. and 175 sq. ft. on the fourth floor.

If a hot water job is laid out on the assumption that a certain size pipe will deliver just one certain assumed amount of heat immaterial of the location of the radiating surface, it will not be surprising to see the system work very badly, the first floor radiators failing to get warm for a long time when the higher placed radiators have too much heat.

After the hot water heating job has been completed by the contractor the system should be regulated in such a manner that all the heating surface should get warmed at the same time and all the return connections from

TABLE SHOWING BASIS FOR FIGURING GRAVITY HOT WATER HEATING

Supply water temperature..... 185° F.
Return water temperature..... 149° F.
Drop in temperature..... 36° F.

1	2	3	4	5	6				
Floor	Distance from Center of Boiler to Center of Radiator in Feet	Available Water Head in Inches for (185° to 149°) 0.148 in. per Foot Height	Assumed Length of Connections and Resistance in Feet	Available Water Head in Inches per Running Foot	Capacity of Pipes in Square Feet (170 B.T.U. per Square Foot)				
					½-in.	¾-in.	1-in.	1¼-in.	1½-in.
Basement...	3.5	0.52	80	0.0065	11	32	57	127	180
First floor...	6	0.89	100	0.0089	13	39	70	156	221
Second floor.	19	2.8	125	0.0224	22	62	130	238	377
Third floor..	31	4.6	150	0.0307	26.5	74	160	290	450
Fourth floor.	42	6.2	175	0.0355	29	81	175	314	490

the radiators have about the same temperature.

To accomplish this it will always be necessary to throttle most of the valves in the higher stories or open the valve just a certain number of turns which, however, invariably will be violated by the occupant of the room in not paying any attention to probable instructions. Inserting washers with holes punched through them is done quite often with good results.

From the accompanying table we learn, therefore, that it is of great importance in a hot water system to proportion the pipe sizes very carefully according to the available head and, as the commercial pipe sizes will be either too large or too small than those required for certain given conditions, the regulating, testing and inserting resistance, are of vital importance to the satisfactory working of a hot water heating system.

*Heating a Swimming Pool**

By C. Teran.

A swimming pool is generally a luxury, not a necessity. For this reason not many are built, and a description of the system installed for Mr. Herbert Coppell at Tenafly, N. J., may prove of interest.

It is housed in a building of one story, and includes the pool room, two dressing rooms, boiler and coal rooms, all on the ground level. The pool is sunk below grade, is built of concrete, waterproofed and lined with English size enameled brick. It is 38 ft. long, 15½ ft. wide and 6 ft. mean depth below water level. The cubical contents are, therefore, 3,534 cu. ft.

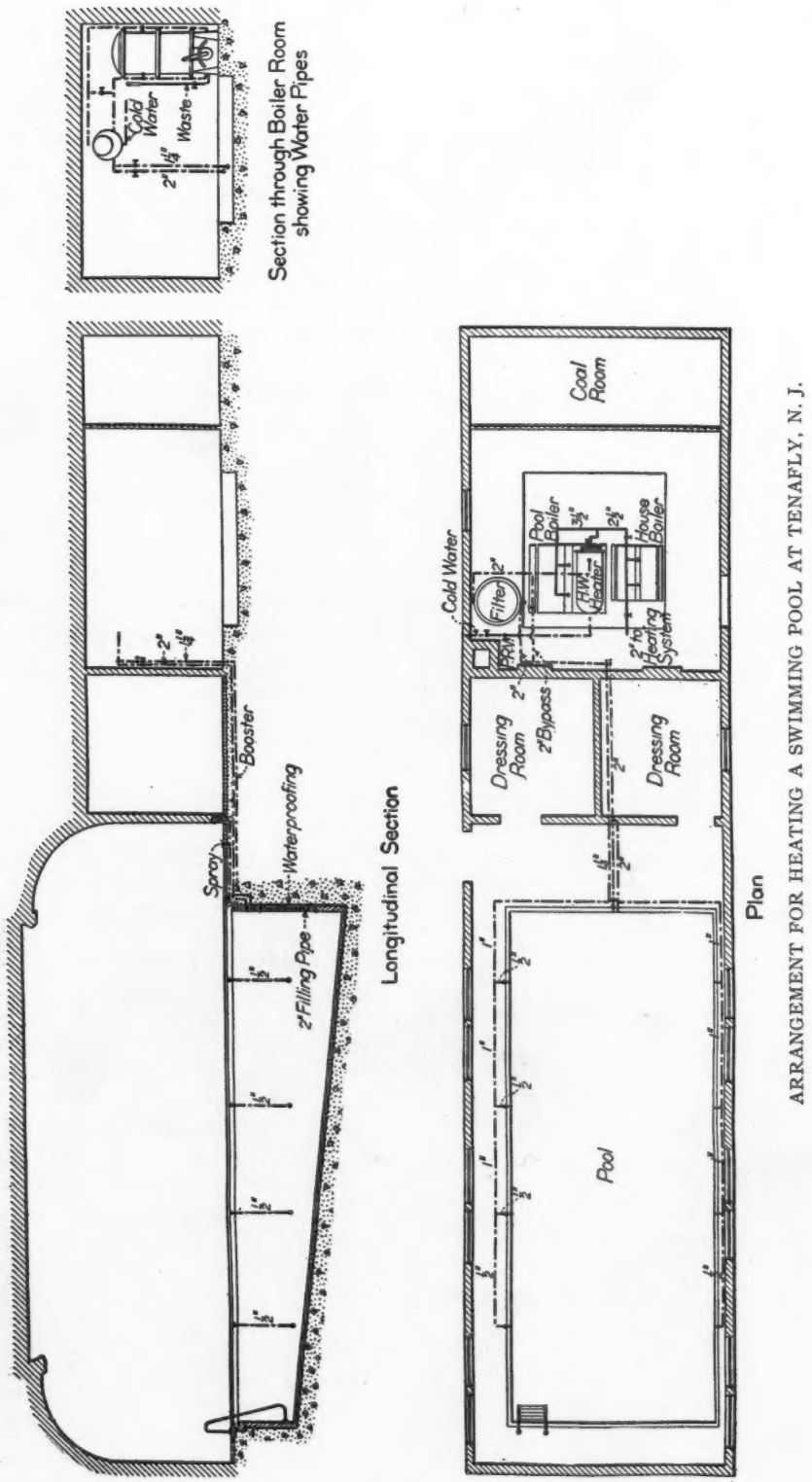
The heating plant was designed to heat this volume of water in 10 hr., or at the rate of 353 cu. ft. an hour. Ten hours is a convenient length of time for heating the water, because the required apparatus is not specially large. If the apparatus was much smaller it would, of course, require a longer time to heat the water, and this time added to that necessary to empty and clean the pool would make the period of time which the pool would be out of commission too long. The time required to empty and clean this pool is 4 to 5 hr.

The installation includes two cast-iron sectional boilers, a Berryman service heater and a filter. The water is reduced to 30 lb. pressure on entering the building. It is then heated in the Berryman heater by steam generated in the boilers, and it is then filtered and discharged into the pool. For filling a main inlet it used; this enters the pool at the deep end near the bottom; there is also a nozzle above the waterline which is used to produce a spray over the pool.

On account of the proximity of the walls of the pool to the outside ground a loss of heat in the water was anticipated and provision made to replace the loss. Careful consideration was given to the various methods that could be used to accomplish this purpose, and injecting water heated to a high temperature into the filled pool was decided upon. The reason for using a high temperature is that the water is not taken from the pool to be reheated, as this would necessitate a circulating pump, but fresh water is used, and by heating it to a high temperature a minimum quantity of water is required and less coal burned. Steam was not considered a good medium, because it imparts a peculiar odor to the water, due perhaps to the presence of oil in the boiler. The water is injected at four points on each side of the pool near the bottom, through nozzles passing through the brick lining and flush with it. This arrangement gives a good distribution, and is neat in appearance. It is found that during the winter months the water loses 2 to 3° F. in 24 hr.

In filling the pool the water is

*Presented at the annual meeting of the American Society of Heating and Ventilating Engineers, New York, January 23-25, 1912.



ARRANGEMENT FOR HEATING A SWIMMING POOL AT TENAFLY, N. J.

heated to 75° F., which, on account of heat losses in transit, etc., gives an ultimate temperature of 70° F. The water injected to make up the heat loss is heated to 180° F.

The large boiler is used to heat the water when the pool is being filled. This was computed as follows:

Cubical contents of pool.	3534 cu. ft.
Cubic feet of water to be heated per hour.....	353 cu. ft.
Pounds of water to be heated per hour.....	353 × 62.4 = 22027
Rise of temperature of the water from 40 to 75 = 35°.....	
Heat units transmitted to water per hour, 22062 × 35.....	771,000 B.T.U.
Coal necessary to be burned per hour 771,000 ÷ 8000.....	96 lbs.
Grate area 96 ÷ 8.....	12 sq. ft.

A boiler having a grate 40 in. wide by 48 in. long was installed. The other boiler shown is used to heat the building and to heat the water injected into the pool to make up the daily loss of heat; by this arrangement, the necessity of keeping a fire in the large boiler is avoided. As there was no sure method of perdetermining the loss of heat of the water in the pool, in selecting this boiler liberal allowance was made for this purpose above what is required to heat the building. The amount of direct radiation in the building is 400 sq. ft., all behind screens; the boiler is rated at 1,000 sq. ft., and has a grate 21 x 27 in., or about 4 sq. ft.

The service heater was specified of proper size to heat 2,800 gals. of water per hour from 40 to 80° F. with low pressure steam, and it was left to the manufacturers who furnished it to design the proper size heater for this duty. The filter was specified in a similar manner. No automatic temperature control was installed, and none has been found necessary. An even temperature of the water is attained by maintaining a steady fire and regulating the flow of water by hand.

As a matter of precaution against a leaky pool the water pipes were installed so that they do not pass through the waterproofing of the wall of the pool below the waterline. This was accomplished by installing the pipes horizontally under the floor of the pool room and dropping branches to the proper depth in the pool between the waterproofing and the brick lining. All concealed water pipes are brass; other pipes are galvanized iron.

The pool, which may be considered an experiment, has been so satisfactory that Mr. Coppell has ordered built a much larger pool, 44 ft. long by 26 ft. wide, with the addition to his house and the equipment for the new pool has been designed on the same principles as the one described.

Vacuo Hot Water Heating by Forced Circulation

By Ira N. Evans

An exhaustive discussion of forced hot water heating, contained in a paper by Ira N. Evans, presented at the recent Annual Meeting of the American Society of Heating and Ventilating Engineers, included some valuable curves, showing the operation of the plant in the Hoboken terminal of the Lackawanna Railroad. On account of the length of this paper it is necessary to defer the publication of the plant operation figures to a later issue.

The principal points of Mr. Evans' general discussion of the subject of forced hot water heating are presented herewith:

Hot water heating by forced circulation has been on the market in various forms for about 18 years, but the majority of owners and engineers have but slight conception of its possibilities, as there is a dearth of literature on the subject. All systems of hot water forced circulation require a pump in the circuit, but differ in the forms of heaters and their connections and methods of handling the steam

and condensation. In the first installations the pumping capacity was comparatively small in proportion to the heating surface and this error has caused many installations to be inefficient to operate and costly to install.

The hot water system by forced circulation comprises the following apparatus in a completed circuit:

1. A live steam heater utilizing steam direct from the boilers under high pressure;

2. An exhaust heater for the use of exhaust steam from power either at atmospheric pressure or below;

3. Two turbine pumps either motor or steam turbine driven for the mechanical circulation of the water. The pumps and heater should be connected by the water pipes in series with by-passes and valves, as shown in Fig. 1.

4. Mains, piping and radiators, which transfer the heat to the space heated, thus completing the circuit.

There have been many variations of the arrangement, none of which have proved so satisfactory in operation. Hot water boilers have been used, displacing the live steam heater, and a reducing valve connection is simetimes made to the exhaust heater for a live steam connection when the exhaust steam is insufficient. The use of hot water boilers is obviously poor practice, as the regular steam boilers when not operated for power are available to furnish live steam for heating. The hot water boilers would be idle in summer and the fires are difficult to regulate to suit outside temperature changes.

An arrangement advocated is the placing of the live steam heater and exhaust steam heater in parallel as regards the water connection, but this has the effect of reducing the capacity of the heating surface in the heaters if used together as only one-half of the water in the system flows through each heater, reducing the velocity. The higher temperature steam available in the live steam heater over the temperature of the exhaust in the other makes the advantage of the series connections apparent.

The live steam heater as indicated in Fig. 1, is placed over the boilers as high as conditions will permit to obtain a gravity return for the all live steam used on the system. The condensation returns to the rear drums of the boilers by gravity at nearly the same pressure and temperature as the water in the boilers. When the condensation of the steam is so heavy that the pressure in the heater is reduced below that of the boiler to an extent greater than the column of return water between the level of the water in the heater and the water line of the boilers, the operation is as follows: An injector tee J and a separate 1-in. steam line from the boilers inject the water back into the boilers and overcome the difference in pressure between the heater and boiler. This injector will generally be required if there is less than 10 ft. between the water line of the boilers and the bottom of the heater under conditions of extreme service.

When only a portion of the heater capacity is required the steam valve to the heater is throttled to the point desired and the condensation covers the tubes, thus reducing the amount of exposed heating surface automatically without interfering with the equal expansion of the tubes and the shell.

When the throttle valve on the heater is wide open and a further capacity is desired, the injector tee is employed. The fact that the bottom of the heater is full of water at a lower temperature and pressure than the boiler makes the conditions favorable for the action of the injector. It should not be unnecessarily used; warning is given by a slight snapping in the return pipe which shows that it is emptying.

When a pump and receiver are used with a live steam heater the latent heat in the exhaust of the pump nearly equal or exceed those in the returned water, and as a rule a vapor pipe is provided on the receiver and a drain trap is placed between the receiver and the heater. Part of the discharge from the trap will re-evaporate because the pressure is lowered and is lost through the vapor pipe. The difficulties with pumps handling

condensation at high temperatures are well known.

In practice there is nearly the same loss and effect in passing steam through a reducing valve, due to wire-drawing, etc., as passing the steam through a steam engine, notwithstanding the superheating effect.

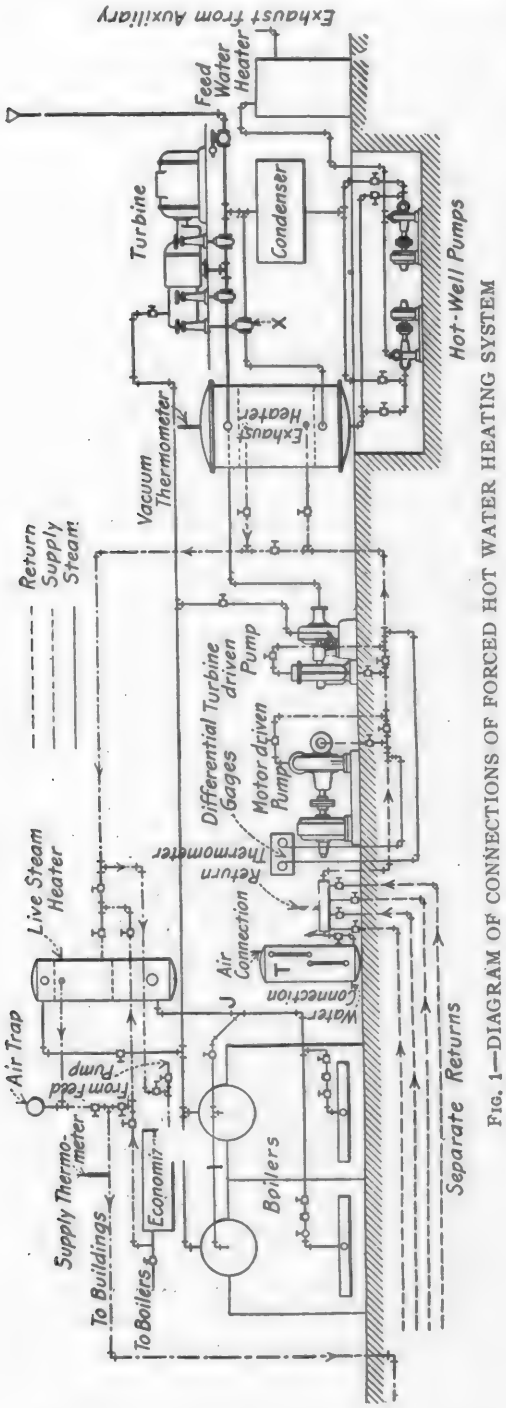


FIG. 1—DIAGRAM OF CONNECTIONS OF FORCED HOT WATER HEATING SYSTEM

The boiler steam is surrounded in the heater by the circulated water and except for the slight radiation from the efficiently covered shell any loss by releasing the pressure from the condensation is impossible. Both water and steam circuits are hermetically sealed and what heat is not passed into the heating system must go back to the boiler in the condensation under nearly the same pressure and temperature as the boiler steam, only the latent heat being utilized. This is in direct contrast to the method of reducing the boiler steam to nearly atmospheric pressure and handling the condensation by a pump or other method involving a release of pressure and loss of vapor and condensation.

The losses are due largely to the conditions of practical operation and in many cases would not appear in a theoretical discussion. They may be considerable when the vacuum pump of an exhaust-steam apparatus requires a stream of injection water as large as 1¼ in. to cool the return, as this is entirely overflow with reference to the heating system itself. If a live steam heater of a hot water system is connected with pumps or traps its economy is destroyed and the live steam may just as well be turned directly into the exhaust heater.

For the above reasons when live steam is handled direct to the boiler by the injector method there is a saving of about 10 to 15% on the amount used and the difficulties in the proper connection of a return trap are avoided.

DESIGN OF LIVE STEAM HEATER

The live steam heater should have a capacity sufficient to heat the water for the entire plant under maximum conditions without the exhaust heater. When operating on a condensing plant the connection between the engine or turbine and the condenser are made as indicated; the amount of vacuum on the heater regulates the water temperature and is controlled by opening or closing the valve X. There may be full vacuum on the condenser with other units exhausting

into it. The dry-air pumps and condenser circulating pumps are not shown. The hot-well pumps handle the condensation from the condenser and heater and are cross-connected. They discharge to the open feed-water heater. If the heater can be placed above the condenser the same hot-well pump could handle the condensation from both.

The remainder of the valves about the heater are for shutting it out when operating under full vacuum. This change is made with this arrangement without stopping the main machine.

It is impossible to get perfect operation under all conditions by combining the heater and condenser in one machine. The power determines the amount of steam furnished and the rate per kilowatt-hour is fixed by the amount of vacuum desired to heat the hot water for any given condition of outside weather. When the plant is to be operated non-condensing the steam connection to the exhaust heater leads to the atmosphere in the usual manner without a back-pressure valve. The only reason for using a back-pressure valve occurs when the exhaust heater is too small and it is desirous to raise the pressure and temperature of the exhaust steam. This has the effect of increasing the amount of steam available by creating a back-pressure on the engines. It might also occur that when the exhaust steam just balances the heating by the use of a relief valve a vacuum might be created by the heating system corresponding to the temperature of the outboard water. When the live and exhaust steam heaters are connected so that the condensation of both is handled by a pump and reservoir, the live steam heater might be omitted and a reducing valve and back-pressure valve connection made to the exhaust heater.

It will readily be seen that where the exhaust heater is operated below atmosphere a trap will be useless for removing the condensation unless sufficient fall is available. The two heater arrangement, as described, embraces all the operating advantages of a high-pressure steam system and a low-pressure vacuum system without the disadvantages of either outside of the initial cost of heaters and pumps. The circulation on the water system is independent of the temperature of the medium.

When the exhaust steam is inadequate in extreme weather and sufficient in average weather, in the case of a non-condensing plant, it is economical to install a live steam heater with a drain trap, flashing the condensation into the steam space of the exhaust heater, with a pump to remove the condensation at the low temperature from the latter. During periods of moderate weather when the live steam heater is not required a vacuum corresponding nearly to the temperature of the outboard temperature of the heating water may be carried. This would be uneconomical were a large quantity of live steam required nights on account of the necessity of pumping the condensation to the boilers.

In the use of brass-tube heaters the construction has been the same as for feed-water practice, the water passing through the tubes with comparatively low velocity and small volume. In hot-water heating these conditions are reversed. The velocities in the mains should be from 5 to 10 ft. per second for satisfactory results and first cost. When the tubes are made small the friction head increases rapidly, and if the area is increased to minimize the friction head, the velocity is reduced. The author believes that nothing less than 1½-in. tubes should be used for this purpose to maintain the velocity through the heater and not increase the friction head unnecessarily.

If a 10-in. main is taken as an example at 10 ft. per second the required number of tubes of ¾, 1, 1¼ and 1½-in. diameter to give the same drop in friction head per unit of length is shown in the accompanying table, and the area will have to be increased proportionately and the velocity reduced.

It is desirous to maintain high velocities through the heater to increase the transmission, and the use of small tubes defeats the very object except

Size of tube, inches	¾	1	1¼	1½	2
Number of pipes having the same friction as 10-in. tube	651	349	170	114	59
Number of pipes having the same area as 10-in. pipe	149	91.7	52.6	38.65	23.4
Ratio of reduction in velocity in maintaining same friction loss as occurring in the 10-in. pipe	0.22	0.26	0.31	0.34	0.4
Increase in area in number of times, over the 10-in. pipe for the same friction per unit length	4.54	3.85	3.23	3	2.5

at the expense of friction head. It will be seen that the area would only have to be doubled with a 2-in. tube to obtain the same drop in friction, and if the area of the pipe was taken in 2-in. tubes doubling the friction head for the length through the heater, the velocity would be the same in heater as in the main, or 10 ft. per second, and the friction head loss would not be excessive through the heater. If a ¾-in. tube were used and the same velocity or area maintained, the friction would be 4½ times.

PUMPS

When the exhaust of the main units is sufficient, it is good practice to use one motor pump and one steam-driven pump for use when the main engines are inoperative. These pumps should be of the turbine type with hollow bronze followers of proper head and capacity. The connection should be made in series, as shown in Fig. 1, and each pump should be of ample capacity to handle the entire plant. As it is only the expense of one or two valves it is best to so connect them in series that both can be operated at the same time. The standard pump may be all right for the circulating head and too light for the static pressure. These data should be given the manufacturer that he may strengthen the casing if necessary. Solid follower pumps are very inefficient, and it is preferable to use high-speed hollow bronze follower turbine pumps with motors or steam turbines for prime movers.

If the main is sufficiently large they can be operated in parallel, and then they are at a disadvantage when operating singly. These connections are especially advantageous where the exhaust steam is used under partial vacuum in extreme weather. The average temperature of the water may be reduced 5° or 10°, which counts heavily in the reduced vacuum required when near atmosphere. There is nothing gained by operating two pumps having the same head and volume in parallel when the mains and plant are designed so that one pump is sufficient. The frictional resistance of the piping is constant for a given velocity, and varies as the square, and the only way the discharge can be increased is by placing the pumps in series and adding the operating head of each pump together. Piston pumps have been abandoned, as they are not applicable to low heads and large volumes, and with the static head balanced on the supply and return the pump valves make a racket that is heard throughout the piping system.

The apparatus should be full of water with 15 lbs. above the static head, and entirely free from air for good results. The pumps should have to operate only against the friction head of the piping. The water should be circulated as rapidly as possible at all times, thus reducing the temperature drop and the average temperature of the circulated water. Changing the temperature of the heating system by varying the amount of steam introduced into the heaters is better practice than varying the speed of the pumps and the circulation.

The rapid circulation also increases the transmission of the surfaces in both heaters and the radiation thereby increasing their efficiency.

It has been found by actual experiment that about 80% of the mechanical energy of the pump reappears in heat which is absorbed by the circulated water, therefore slightly raising

its temperature. The friction and consequent heat are caused by the rapid movement of the water against the sides of the pipe. As the exhaust steam from the prime mover of the pump is also used in the heater it will be seen that ample circulating power is not so expensive as at first considered.

EXPANSION TANKS

There are two methods of providing for the expansion of the water, one as shown in Fig. 1 with the expansion tank at the base of the system and the other as in Fig. 2, where it

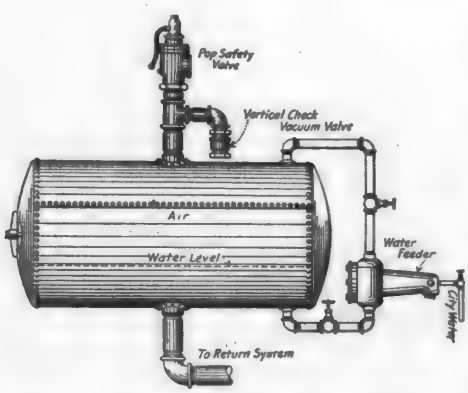


FIG. 2—EXPANSION TANK AND CONNECTIONS AT HIGH POINT

is placed at the highest point. The cubic contents of the tank can be readily calculated in any case by allowing 150° rise in temperature and about 1½ pints of water for each square foot of radiation. The tank is kept about 25% full of water. The water level is manipulated by hand by using the air pressure to force water into the system and is always under the eye of the operator who is immediately advised of any loss of water in the system by the change in the level in the tank.

An automatic air trap releases displaced air at the top of the system by opening when no water is present and closing when the water raises the float. In smaller installations and places where the construction compels the use of the overhead expansion tank with the water feeder, it should be arranged as in Fig. 2. Gauge glasses should be provided to show the water level in all cases. In large installations where air pressure is available, the arrangement in Fig. 1 is preferable.

HOT WATER HEATING MAINS, WITH FORMULA

The mains should be designed with the use of a well-tried friction formula. The one the writer uses is

$$h = f \frac{l}{d} \frac{v2}{2g}$$

and q = a V W in which

h = loss in head in feet.
f = factor for different sizes and velocities.
l = length in feet.
d = diameter in feet.
v = velocity in feet per second.
g = 32.2, or the acceleration of gravity.
q = quantity per minute in pounds.
a = area of pipe in square feet.
V = velocity in feet per minute.
W = density in pounds per cubic foot at the average temperature.

The drop in head on all circuits should be nearly the same and equal to the total head of the pump. This makes the design of all mains dependent on the velocity and discharge which gives different size mains in many cases for the same amount of heating surface.

PIPING DESIGN FOR MONTEFIORE HOME, NEW YORK

Fig. 3 shows the riser diagram and scheme of arrangement of mains for the new Montefiore home, New York City, Arnold Brunner, architect, and A. M. Feldman, consulting engineer. This is a very satisfactory arrangement. There is a single supply on the basement corridor ceiling and a separate return for each building in the tunnel, the arrangement thus enabling the engineer to control the circulation to each building independently. A valve and thermometer are provided at the return header in the engine room for each return. The separate return will not cost much more than a large single return and the advantages gained fully warrant the arrangement. All the buildings are supplied with an overhead system with single risers. The

radiators are shunted off from the riser with a 1¼-in. connection and there is a total of 60,000 sq. ft. of heating surface on the plant.

EXAMPLE SHOWING APPLICATION OF FORMULA

An application of the method of working on the basis of the formula given may be made in connection with Fig. 3, particularly to find the relation of velocities in the main and shunt and

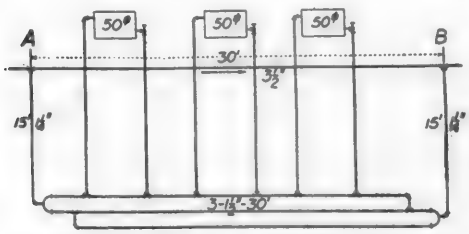


FIG. 3—RISER DIAGRAM TO ILLUSTRATE SHUNT CALCULATION

also the dropping temperature with a 1¼-in. connection; thus:

$30 \div 2.3 = 13$ sq. ft.

$30 \times 3 \div 2 = 45$ sq. ft.

say, 70 sq. ft. of surface in the coil + 150 = 220 sq. ft.

Assume the maximum water temperature at 210° and the room temperature at 60° or 150° difference; also 1.8 B.T.U. as the transmission factor. Then $220 \times 1.8 \times 150 = 59{,}400$ B.T.U. per hour required.

$59{,}400 \div 60 = 1{,}000$ B.T.U. per minute.

Area of 1¼ in. pipe is 1.50 sq. in.; the diameter 0.115 ft.

Area of 1½ in. pipe is 2.04 sq. in.; the diameter 0.134 ft.

Area of 3½ in. pipe is 9.9 sq. in.; the diameter 0.297.

The length of the three 1½-in.; pipes to terms of 1¼-in. pipe is $3 \times 2.04 \div 1.5 = 4.08$. Thus the velocity in the coil will be 1/4.08 of that in the 1¼-in. pipe.

The velocity varies as the square, of the diameter

$(1/4.08) \times 30$ (ft.) $= 30 \div 4.08 =$ 7.35 ft.

the length of 1¼-in. pipe to be equivalent friction of the three 1½-in pipes. The relative lengths will be 37.4 ft. for 1¼-in. and 30 ft. for the 3½-in. pipe. The drop in head regardless of velocity between points A and B will be the same for both shunt and main.

For this discussion, we will assume the same friction factor, 0.02.

$$h \text{ for } 1\tfrac{1}{2}\text{-in. pipe} = f^1 \frac{l^1 v^{1\,2}}{d^{1\,2} 2g}$$

$$h \text{ for } 3\tfrac{1}{2}\text{-in. pipe} = f \frac{l v^2}{d^{\,2} 2g}$$

Cancelling common factors:

$$0.02 \times \frac{37.4}{.115} \frac{v^{1\,2}}{2g} = 0.02 \frac{30}{0.297 \times 2g} v^2$$

$11.11\ v^1 = 3.45\ v^2$

$v^{1\,2} = 0.311\ v^2$

$v^1 = 0.56\ v$; also $v = 1.8\ v'$

or the velocity in the shunt will be 0.603 that of the main.

$9.9 \div 144 \times 6 \times 60 = 24.75$ cu. ft. of water per minute flowing, assuming a 6-ft. per second velocity in the 3½-in. pipe determined previously by the requirements of the buildings supplied. Then

$$24.75 = \frac{9.9 \times 1.8\ v^1}{144} + \frac{1.5\ v^1}{144}$$

from the fact that the area of the shunt times its velocity plus the area of the main times its velocity must be equal to q or 24.75 cu. ft. per minute.

$3564 = (17.82 + 1.5)\ v^1$

$3564 \div 19.32 = v^1 = 184.5$ $184.5 \div 60 = 3.07$ ft. per second in the 1¼-in. shunt.

$3.07 \times 1.8 = 5.53$ ft. per second, the velocity in 3½-in. main within the shunt.

solving for the friction head in both, which is equal,

$v^1 = 0.56\ v$; also $v = 1.8\ v^1$

$$h = f \frac{l}{d} \frac{v^2}{2g} \text{ and } f = 0.0295$$

$$h = 0.0295 \frac{37.35}{0.115} \frac{(3.07)^2}{2g}$$

$$h = 0.0295 \frac{37.35}{0.115} \frac{(3.07)^2}{2g}$$

$h = 1.33$ drop in head for the coil.

When the radiator is first turned on, the contained cold water has to be

raised to the main and the pressure due to gravity which has to be overcome will be as follows: We will assume as a maximum the water in the main is 200° and that in the coil 50°. Water weighs at

50°.....62.41 lbs. per cu. ft.
Water weighs at
200°.....60.14 lbs. per cu. ft.

Differences.....2.27 lbs. per cu. ft.
$2.27 \div 144 = 0.016$ lb. per sq. in.
$h = 2.3$ p, in which h is the head from Merriman's "Hydraulics."
$0.016 \times 2.3 = 0.0368$ ft. head for each foot of height.
as there is a 15-ft. rise in the pipe, the head due to gravity to be overcome will be

$$0.0368 \times 15 = 0.55 \text{ ft. head.}$$

As the friction head is 1.33 ft., this will be sufficient to raise the cold water and start the circuit, and as the cold water is displaced, the 0.55 ft. head will be reduced to 1/15 when the coil is circulating normally, or $0.55 \div 15 = 0.036$ ft. if the drop is 10°.
$1.5 \div 144 \times 60 \times 3.07 = 1.92$ lbs. per second.
$1.92 \times 60 = 115.2$. lbs. per minute.

1,000 B.T.U. $\div$ 115.2 = 9° drop in the coil under maximum conditions. This is not exactly correct, as the friction factor for 3½-in. pipe is 0.025, and the velocity is 5.5 ft. per second, but it would not make any material difference.

AIR TRAPS

Provisions should be made to relieve the air at all high points by automatic air traps, but using as few as possible. Any good drain trap turned upside down and so constructed that the valve is above the water level when closed will answer the purpose. If the trap valve is not out of the water when closed, a slug will be blown out each time it discharges. It should be so connected that a vacuum cannot be produced in the trap when it is closed and hold the water level higher than that in the system, thus preventing its operation. The discharge should, in any case, be connected to some point so that if it does leak it will do no damage.

A sketch of a common form of air trap is shown in Fig. 4. These must be carefully tested before being put in place, as they are very liable to leak and not seat properly. Dirt will tend to accumulate in the outlet when the traps do not operate for a considerable time; this dirt works down on the seat of the valve and prevents it from tightly closing. For these reasons the reversed steam-drain trap with its float and lever will give greater satisfaction,

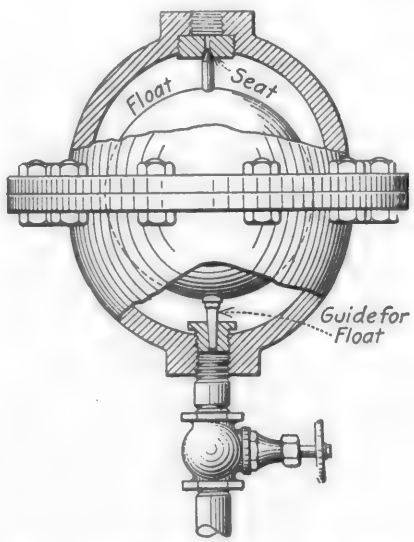


FIG. 4—COMMON FORM OF AIR TRAP

there being more pressure to seat the valve.

All radiators should be provided with key air valves whether needed or not. Where mains are reduced, eccentric fittings or reducers should be used so that the level of the top of the pipe will be maintained without air pockets. The piping should be so arranged and sized that no bypasses or short-circuits occur. The velocity necessary on a proper working hot-water system should be something over 5 ft. per second in the mains, depending on the size, distance and total head on the pump.

Lock stop valves should never be used to equalize the flow for different sections of radiators; in cases where this is made necessary the arrangement of mains is at fault. Individual regulation of the different sections should

be at the main header in the engine room only.

The same velocities cannot be used for the mains throughout on a hot-water system on account of the wide range in loss in head per unit distance of length for the different pipe sizes. The mains cannot be designed properly according to a constant number of square feet of heating surface for each commercial size, as the drop in temperature on the system, head on the pump and distance vary the discharge of water. A 2-in. pipe may take care of 2,000 sq. ft. of surface in one portion of a plant and be too small for 1,000 sq. ft. in another section. These points are mentioned as many plants have been laid out on this basis and may have worked fairly well, but due to poor and unequal circulation the main advantages of the system are lost, viz., small drop in temperature, low temperature of outboard water in extreme weather. The entire system may operate on 10° higher temperature of water just to meet the requirements of a small percentage of the heating system.

The proper discharge in gallons and total head should be carefully determined in advance so that the pump manufacturer may furnish a properly designed pump. It is then good practice to see that he delivers what is called for by measuring the head and gallons after installation. Many cases have occurred where the manufacturers' test curves showed proper design and when the apparatus was installed an overload was found on the named capacity and head.

RADIATION FOR FORCED HOT WATER NO GREATER THAN FOR LOW-PRESSURE STEAM

Due to the practice of using low water temperatures and large differences between the supply and return on gravity water systems, the idea has become prevalent that hot-water systems require more radiation than for low-pressure steam. This is not so as the circulation of steam, even when vacuum is applied, is apt to be hindered by air at times, or if the pressure is very low and the connections are small, a vacuum may be produced in the radiator, thus cooling a portion of the surface because of the heavy condensation and inadequate steam supply. This occurs often on indirect radiation with cold air supply.

In the case of hot water with forced circulation, due to the high specific heat of the water and a positive and rapid circulation, the transmission of the heating surface is greater than with steam for the same temperatures. If the water is operated at a temperature of 200° average, with a drop on the system of 20° or less, the same amount of radiation will be ample that would be required for a steam system operated at atmospheric pressure, or 212°. The maximum temperature of the water is determined entirely by that of the gases or steam used in the heaters. If high-pressure steam is used with no exhaust the water may be circulated up to 280° and a corresponding reduction made in the amount of heating surface installed over a system designed to operate on 200° and below.

It is safe to calculate the radiation for water systems of this type in the same manner as for steam systems with the same temperature and corresponding pressure, with the added assurance of a positive circulation.

Leaks can be eliminated by proper testing, inspection and selection of the material entering construction. The fittings should be of the heavy water pattern, such as are required for sprinkler work, of good iron and tapped solid with no bushings, as they invariably are the source of leaks. Fifty pounds of steam should be used as an expansion test on the piping before the radiators are connected. The radiators should be tested to 100 lbs. before being placed in the building and the whole system should then be tested to 100 lbs. before and after the radiators are connected and before the system is placed in regular service.

All water radiators have a top and bottom connection to each section, and the supply connection is always made at the top of the radiator. In this type of radiator steam circulars 50% better than in the regular steam radiator

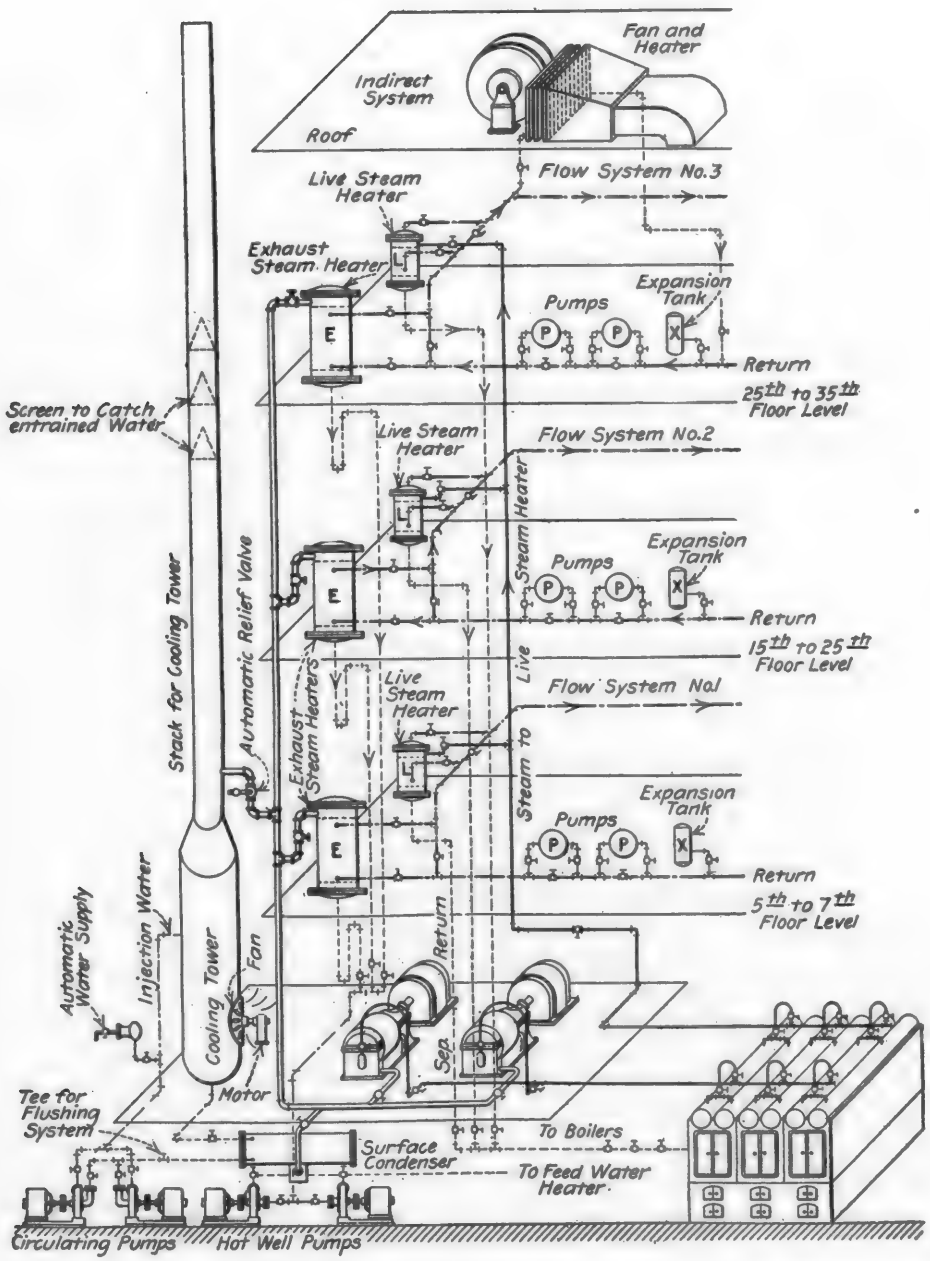


FIG. 5—DIAGRAM OF HOT WATER HEATING SYSTEM PROPOSED FOR HIGH BUILDINGS

with a single bottom connection, and the difference in price is very little. Owners and architects would do well to insist on the use of double-connection radiators, whether steam or water were used, as the system would be interchangeable at slight expense and the circulation would be better.

ARRANGEMENT OF FORCED HOT WATER HEATING SYSTEM FOR HIGH BUILDINGS

The hot-water system may be applied to the highest buildings, the engines or turbines operated condensing and the temperature of the circulated medium varied so that without shutting off the radiation the rooms will not be overheated. The most economical feature in the operation of such a system is the fact that the temperature of the water can be varied from 200° to 100° with a corresponding saving in heat whether exhaust or live steam is used for heating. No more heating surface is required than for vacuum systems as the medium in zero weather is at the same temperature in both cases.

Figs. 5 and 6 show diagrammatically how a hot-water system may be arranged for a building of any number of stories, the power plant operated condensing all of the time and the heating system utilized as a condenser to the extent of its capacity at any given outside weather condition. To reduce the static pressure on the radiators the system is divided into several independent units, utilizing the steam from a common source.

The arrangement shown contemplates one supply and one return pipe to the various stories. Each floor is divided into one or more sections and served by a single 1½ or 1¼-in. pipe, depending on the amount of surface and floor area, and the radiators are connected in shunt or out and back into the same pipe. This pipe may be run behind a removable base, or it may be run between the sleepers carrying the finished floor. Under these conditions a 1½-in. pipe will take care of 1,000 sq. ft. of radiation and a 1¼-inch pipe will supply 600 to 800 sq. ft. of surface with the same drop in head.

The live-steam heaters L, which are very small, connect with independent steam and return lines from the boilers; the condensation is thus returned by gravity to the boilers without pumping or releasing the pressure.

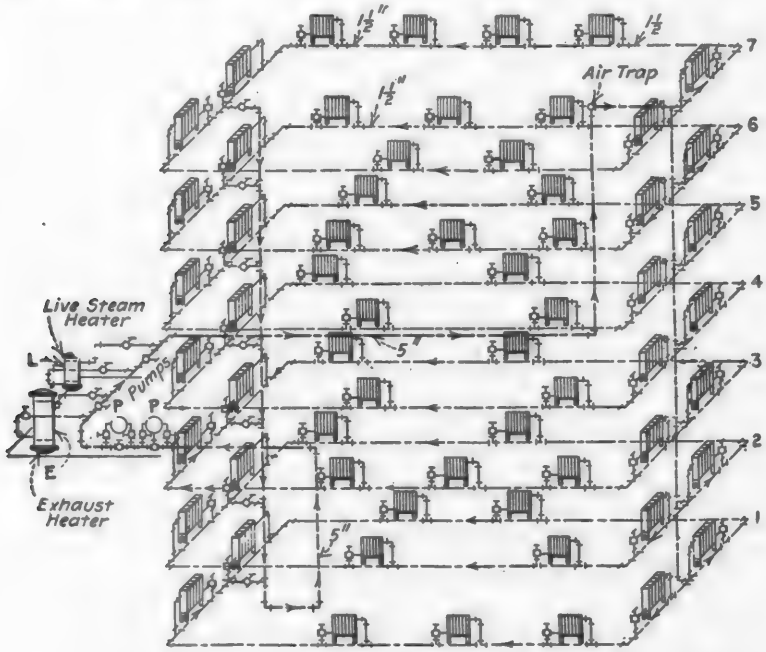


FIG. 6—ONE UNIT OF HEATING SYSTEM COVERING SEVEN FLOORS

Full boiler pressure may be used, and by throttling the individual returns any temperature may be maintained by allowing the condensation to back up and to cover that portion of the tube surface not required in the live-steam heater. The returns need not be over 1¼- or 1½-in.-pipe. The pump capacity need not be over 20 H. P.

The only precaution necessary in this system is to be sure the exhaust pipe is air-tight; this will present no difficulty if the proper material is selected before erection. Each exhaust heater is provided with a single connection with a long drop and loop of pipe not over 2 in. in diameter. The intermittent siphon action of these lines will produce a vacuum and remove the air. The lines lead to a header which is connected to the condenser. A motor-driven pump should remove this condensation to the feed-water heater, where sufficient auxiliary exhaust steam should be provided to raise its temperature to 212° before returning it to the boilers.

On a job of this kind as much of the machinery should be operated electrically as possible so as to load the turbine; at the same time the units should be selected with regard to the heating load.

Where possible, a driven well could be provided with an air lift to furnish the water supply for the injection which is evaporated by the cooling tower. After passing through the condenser the water could be used for flushing the closets, providing an equal amount of cooler water to replace that removed, and materially assisting the action of the condenser. This arrangement would reduce the city-water bill for power and flushing purposes where well-water for boiler use would be unsuited, due to impurities. By installing a turbine the use of cylinder oil is eliminated and distilled water is obtained for the boilers.

FRESH AIR SUPPLY IN PLACE OF CONDENSER AND COOLING TOWER

In case the building was not large enough to require a load that would warrant a condenser and a cooling tower, a fresh-air supply could be arranged on the roof with a fan and indirect stack connected to one of the hot-water systems. This would form an efficient air condenser, and the ventilation of the building could be accomplished at the same time. This would be especially desirable where the average power load was somewhat less than the heating requirements and not large enough to warrant condensing apparatus. The fan system is indicated. The time the building ventilation would be most desired would be in moderate, damp weather, when the heating system would be at low condensing capacity. In very extreme weather the fan ventilation would not be as necessary and the heating system would have greater efficiency as a condenser.

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*Auxiliaries for Pressure Systems of Hot Water Heating**

By J. J. Wilson

Because of the increasing demand and use of hot water heating auxiliaries, such as generators, accelators, impulsers, heat retainers, etc., in hot water heating systems, especially those used for residence heating, the author is led to believe a description of the methods used to install some of these specialties may be of interest. In 1896 he was engaged to design a hot water heating system for a small hotel, having about 41 radiators. After going over the building plans, he decided to have the heating contractor put in a closed or pressure system of hot water heating.

An overhead system was designed with the mains on the fourth story

*Presented at the annual meeting of the American Society of Heating and Ventilating Engineers, New York, January 23-25, 1912.

ceiling, and the expansion tank was placed in an accessible position, between the ceiling and the roof. The author used a lever safety valve on the tank, a chain from the lever down into the room under the tank, upon which chain weights could be placed, to increase the water temperature in the system, when operating. Fig. 1 shows auxiliaries attached to tank.

In 1903 the author designed a hot water heating system for a fire-engine house. The mains were located in the cellar and tank was placed above the highest radiators. Fig. 2 explains the construction at the tank. In both of these cases, good results were secured,

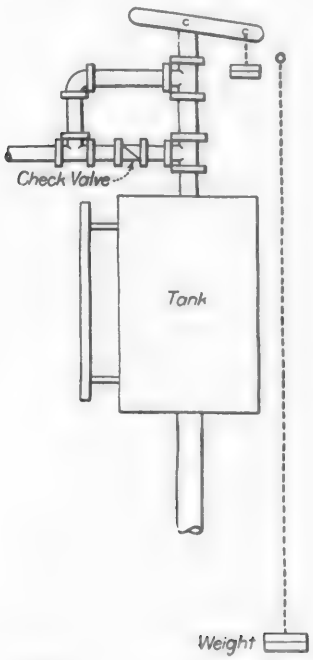


FIG. 2

FIG. 1

as to quick circulation and moderate use of fuel. It is believed that both of these plants are still in use and giving satisfaction.

In 1906 a number of calls were received to design systems of this character, and after trying several specialties used in closed or pressure systems, the author settled on the Phelps heat retainer, shown in Fig. 3. He has designed about sixty systems using this specialty, and in every instance has secured good results in quick circulation; and where proper attention was given to operating the boiler fire, economical results were obtained in the use of fuel.

In 1909 the author was engaged to design a hot-water heating system for a heating contractor who had considerable experience with closed systems of hot-water heating. The heat-

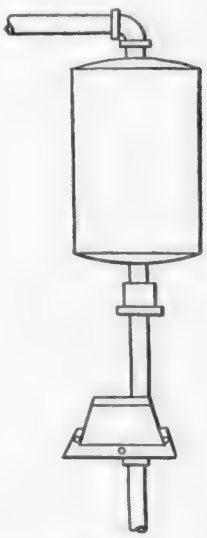


FIG. 3

ing plant was for a residence in the Blue Ridge Mountains, in a location much exposed to high winds and low temperatures. The heating contractor had invented a novel method of installing his expansion tank in the cellar alongside of the boiler and also a system of damper and draft control in conjunction with the other specialties. This system was installed and proved a success. Several plants of this kind were installed in 1910, the inventor making an improvement in the different attachments used. Finally he obtained a patent this summer on the invention, and now has applied for a patent on his draft control.

Fig. 4 shows the tank and complete construction. The tank of 20 gals. is located in the cellar at any desired location, but preferably alongside of boiler. The pipe connecting the bottom of tank with the boiler return has a valve to cut off such connection when desired. The top of the tank has a relief valve on it and an attachment for operating a lever arm that

closes and opens draft door on boiler and the check draft damper on the smoke pipe. On the side of the tank, attached to tank draw off, there is connected a small air pump, similar to those used for obtaining a pressure in gasoline fire pots, and alongside of it on the same run of pipe is connected a pressure gauge.

The operation of the system is as follows: The valve on the line between the boiler and the tank is closed and the system filled with water, as it is usually done, then two buckets or

We find that the system is extremely sensitive to the action of the fire; circulation is very rapid and equable. The most distant radiator from the boiler heats almost simultaneously with the one nearest boiler. As soon as the pressure in the system exceeds the amount desired, water from the system enters the expansion tank and thus increases its weight, causing it to drop through a gland joint in the connection between it and the boiler. In dropping, it tips the damper lever arm, causing the draft door to close

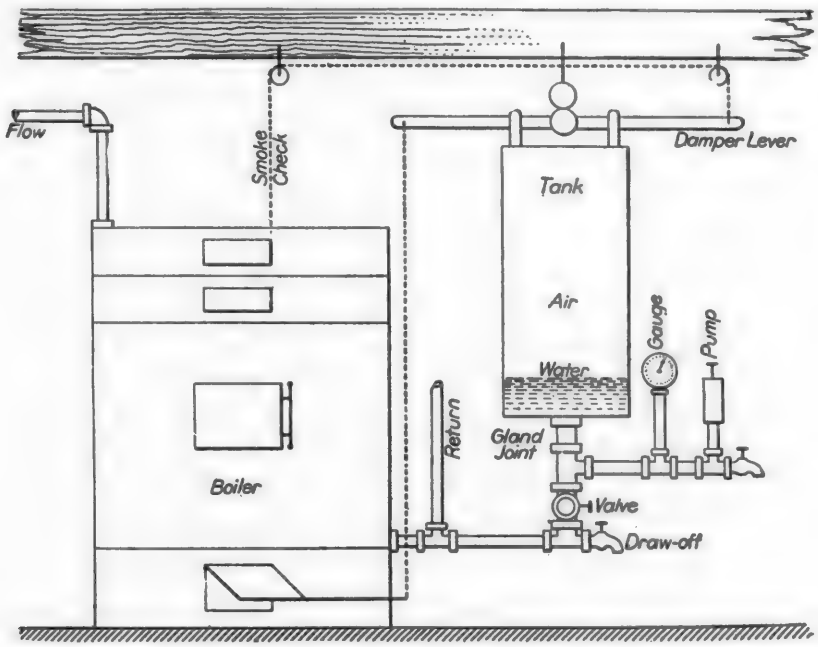


FIG. 4—COMBINED EXPANSION TANK AND DRAFT CONTROL

about 10 gals. of water are drawn from the system. Air is pumped into the tank until, for a two-story residence, the gauge registers about 5 lbs.; for a three-story residence, about 8 lbs., and so on, the object being to have enough pressure to balance the height of water in system, so that the top radiators are kept full of water. Then the valve between the tank and boiler is opened and the gauge will register about zero Fire is then started, and system is operated by means of damper arm at the tank, Draft can be set to close off at any pressure desired. We have used from 4 to 10 lbs. at the gauge.

and the check draft in the smoke pipe to open. As soon as this excess pressure subsides, as it will do, caused by checking the draft, the tank, which is balanced by a counterweight, shown in Fig. 5, resumes its former position, and the draft door of boiler is opened and the smoke pipe check damper closed.

The distance the tank drops from the expansion of water into it is only ½ in. The fulcrum and lever arm multiplies the distance of the tank drop sufficiently to operate the draft door and the smoke-pipe check. The use of the air pump in connection is a valuable feature, as it enables the

operator to have a resilient cushion of air to balance the static height of the water in the system. The relief valve at the top of the tank is designed to make it impossible for the valve seat

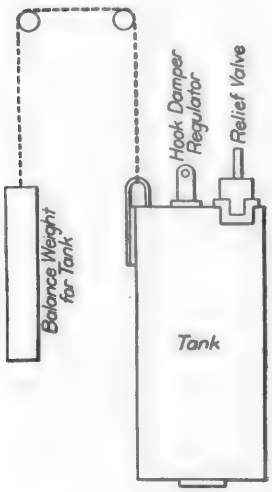


FIG. 5

to stick. So far the inventor has never met the condition of the water escaping from this relief valve. The amount of radiation used to heat rooms connected to this system has been decreased from 10 to 15% of the amount used for an open system of hot-water heating.

The sizes of the flow and return mains are also reduced, their area being not less than the total sum of the area of all radiator connections, which are usually as given in the table.

All branch connections are taken from the side of flow and return

SIZE OF HOT WATER RADIATOR PIPE CONNECTIONS

	Diameter of Pipe, Inches
FIRST FLOOR:	
Up to 50 sq. ft. radiation.....	¾
Up to 100 sq. ft. radiation.....	1
SECOND FLOOR:	
Up to 50 sq. ft. radiation.....	½
Up to 100 sq. ft. radiation.....	¾
THIRD FLOOR:	
Up to 60 sq. ft. radiation.....	½
Up to 120 sq. ft. radiation.....	¾

mains, using two 45° ells to get the proper elevation.

The inventor in experimenting as to the effects produced by high pressure, running at one time as high as 30 lbs., indicated on the tank gauge, notes there does not seem to be any leakage in system, and ascribes this condition to the resilient cushion of air that the water presses against. The locating of the tank in the cellar, together with the other mentioned auxiliaries, in connection with a hot-water heating system, seem to the author to be far in advance of anything heretofore designed for such a purpose. At this writing more definite engineering data, such as outside temperatures, temperatures of rooms, amount of radiation, amount of fuel burned per square foot of grate surface, velocity of water through mains and other desirable data are not available, as the plants are in a distant State, but it is hoped in the near future to be able to supply the information. The system is known as Walter's areo-balance system of hot-water heating, and was invented by Felix Walter, of Highfield, Md., but as yet has not been introduced outside of his personal contracting.

Efficiency in Labor for the Heating Industry

One of the topics for discussion in addition to those on the programme, at the recent meeting of the Heating Engineers' Society was "Efficiency in Labor for the Heating Industry." Norman A. Hill, who spoke on this topic, said:

"In connection with this work, the first item for the consulting or contracting engineer in the heating industry to consider is the plan of business conduct. After perfecting a plan for what we will consider is a corporation, it is necessary to perfect an

organization consisting of two radically different forces, namely, the line and staff. Under the head of "Line" may be mentioned the superintendent; under him the foreman and steam fitters in charge. Under the staff organization for a contractor or engineer, we find the executive officers, followed by the subordinates: the sales or contract department, the accounting and cost department, and the purchasing of material department.

Under "staff analysis" we find the following conditions: in either a contracting or engineering business the men in control possess the executive positions and, therefore, control the policy of the organization and its matters of routine, etc. It is up to their best sense of judgment to conduct the business as they see fit.

"It is not the purpose of these few remarks on efficiency as applied to the heating industry to comment on the conduct of the office organization of either heating engineers or contractors.

"Referring to the topic under discussion as a "line" proposition, particularly for the contractor, an analysis of the worker may be outlined as follows:

"1. Men. The nationality of the worker must be taken into consideration. If he is native-born, the problem of handling him under scientific management is usually simple. If he be foreign-born, the problem has certain complications. In any case, the habits of the worker must be considered and his industry, skill, temperament, character and sobriety. In case he is a member of a local labor union, under any plan of scientific management, he must be handled with tact and discretion.

2. As to the machine. It must, in the first place, be suitable for the work for which it is intended. Provision must be made for proper care of the machine. Furthermore, under scientific mnagement, instructions must be furnished for the workmen, standardizing the work which they must do upon the machine.

3. In regard to materials. The following points must be taken into consideration; the kind and quality of the material purchased, its price to the engineer or contractor, the cost of handling said material, and its installation cost on the job.

4. We must next consider the conditions and methods under which the installation of the job is conducted, whether by a consulting engineer under his direct supervision or by a contractor at a fixed price. Under this heading we have several sub-divisions to consider, in the following order: In the case of installation (being either in the charge of a contracting or consulting engineer) a preliminary plan should be made, subject to the approval and acceptance of the owner and his architect. Certain alterations are reasonably certain to be necessary in this plan, subject to his (the owner's) approval. Then, in the case of a heating contractor bidding on his own specifications, a definite description should be made of all the work intended to be done, and upon the drawings should be clearly indicated the method of installing this work. Having in hand a clearly-defined plan and specifications covering the installation of the work, certain elements of functional discipline should be made plain to the contractors' employees, based absolutely upon the square deal.

The next problem for the contractor is that of traffic, the moving of the material which must be installed in connection with the heating contract. In this connection, I may state that it has been our experience in the last eight years that it is advisable to cut the pipe to dimension in the shop and, under no circumstances is it necessary to cut pipe over 2 in. in size on the job.

In this connection, the thought enters of standardizing the functions of a competent mechanic for steam fitting in the shop. Provided the architects' drawings are reasonably correct, there is no reason why all the large piping for either a steam or hot water job should not be cut and threaded, ready for installation, in the shop. It would seem, therefore, that the largest opportunity for an increase in personal efficiency of the worker is in the shop

of the steam fitter, with competent instructions and accurate measurements taken off the architects' plans and checked up on the job.

In connection with the instruction of the mechanic or steam fitter, certain conditions necessary to the satisfactory operation of an efficiency plan are necessary. In the first place, adequate lighting must be provided in the shop, a sufficient supply of fresh air at a proper temperature is also necessary and, lastly, but not the least important thing, an adequate reward for the worker for his increased efficiency.

Now, as to efficiency and a wage plan, it is absolutely essential that a standard be established in each shop and for each field job; that is to say, work on the contract where it is to be installed. This can only be done after careful "time studies" are made during a period of three to four months and a fair analysis of the results have been tabulated.

As to heating contractors, our experience has been that they really know little or nothing as to the actual cost to them of contract work. They seem to ignore the following facts: Four principal constituents must be considered in any cost analysis of contract work; first, the material used; second, labor used; third, the equipment used; fourth, indirect expense. This last item includes the expense in the office, shop, on the job and "overhead." The last item of expense is generally ignored in making up an estimate to bid on contract work.

In conclusion, I would suggest that the members of this society give some thought to the application of the principles of scientific management to the heating trade. While the experience of our office does not include efficiency service for contractors in the heating business, we believe there is a possibility of an increase in efficiency for the labor element in the heating industry of from 30% to 50%, provided that the principles of efficiency engineering are observed.

It may not be amiss to say that from observations made in the past eight years, we have found that the waste effort in steam fitting labor, owing to the lack of an advance plan, has been from 50% to 60%, and that, under normal conditions, even with union labor, the efficiency of workmen may be easily increased.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Eighteenth Annual Meeting, New York, January 23-25, 1912

If any evidence were needed to show that the subject of heating and ventilation is to-day the topic of the hour, not only in engineering circles, but also in the minds of the public at large, it was amply furnished in the gathering of heating engineers in New York last month. Throughout the meeting the atmosphere seemed charged with the importance of the occasion. Nation-wide comments on present-day heating and ventilating practice were in the minds of all present and here, as members of a national representative body, was the occasion and opportunity of expressing the mind of the profession on the subject. Speakers were present who had advanced the most intelligent criticisms of modern heating methods and in a memorable session, devoted exclusively to ventilation, the discussion assumed the character of a public debate, in which the viewpoints of the engineer, the physiologist and the public were presented in a manner that completely summed up the situation. The conclusion seemed fully proven that

the present state of the art of heating and ventilating represents the best practice so far known of furnishing heat and fresh air to our buildings by mechanical means; that the responsibility rests with the physiologist of furnishing the requirements still needed to maintain the freshness of the air, and that the public at large must make a sharp distinction between the design and the operation of heating and ventilating plants before it is qualified to pass judgment on their efficiency.

This last point found expression in a resolution, prompted by the recent discussions in the public press, of the poor condition of the air in the New York public schools, but which was intended to apply with equal force to any locality where the operation of heating apparatus is not under the direct supervision of the designing engineers. The resolution was offered by D. D. Kimball, chairman for New York State, of the society's Committee on Compulsory Legislation:

Resolution to Place Heating Plants Under Supervision of the Designing Engineers

Be it resolved that this society petition the Board of Education of New York City that arrangements be made whereby the supervision of janitors and engineers operating ventilating plants, supervision of repairs, supervision of plant operation and supervision of fuel supply be placed under the control of the department designing such plants.

Further, that it is most desirable that a limited sum be appropriated for ventilation tests to be made in co-operation with the department, the committee on ventilation of the American Society of School Hygiene and the committee on school house ventilation of this society.

Aside from the public importance of the meeting, the number and quality of the papers presented, the arrangement of the programme, providing for sessions on special topics, and the unusual entertainment features, coupled with the largest attendance in the history of the society, were enough in themslves to make the meeting a notable event for the heating profession. It was felt that the society had progressed splendidly and many enthusiastic expressions were heard on the brilliant administration of the retiring president, Reginald Pelham Bolton, and on the gratifying success of the secretary, W. W. Macon, in advancing the work and methods of the society, an expression which was borne out in his overwhelming re-election as secretary.

One of the direct results of the meeting was the initial step in the formation of a Massachusetts Chapter. An organization was formed with temporary officers and formal organization was scheduled for February 8 at a meeting to be held in Boston.

Afternoon Session, January 23

The meeting was called to order in the Engineering Societies Building, with President Reginald Pelham Bolton in the chair. The report of the secretary, which included a satisfactory financial statement, contained the important announcement that it is intended to send all papers to the members together with a circular suggesting discussion by mail, say within thirty days, particularly as regards papers received too late to reach the members before the meeting. The author will then be given his prerogative of closing the discussion before the information is sent to the printers for the volume of transactions.

The board of governors' report showed a total membership at present of 427 members, as compared with 386 a year ago.

Committee reports were then presented by James A. Donnelly for the committee on tests and by W. M. Mackay for the committee on heating guarantees. These were followed by the reports of the Illinois and New York Chapters. The remainder of the session was devoted to the reading of papers, one on "Heat Exchange Diagram," by N. W. Akimoff, and one on "Drying Apparatus," by H. C. Russell, of Washington, D. C.; and the president's address, which was in the form of a paper on "The Use and Abuse of Fuel."

Evening Session, January 23

The newly-elected officers were announced, as follows:

PRESIDENT:

Prof. John R. Allen, Ann Arbor, Mich.

FIRST VICE-PRESIDENT:

John F. Hale, Camden, N. J.

SECOND VICE-PRESIDENT:

Edmund F. Capron, Chicago.

TREASURER:

James A. Donnelly, New York.

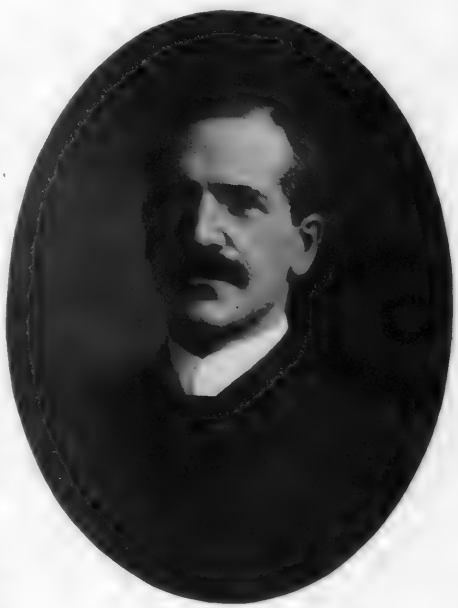
SECRETARY:

W. W. Macon, New York

BOARD OF GOVERNORS:

Reginald Pelham Bolton, New York; Prof. James D. Hoffman, Lincoln, Neb.; Sam R. Lewis, Chicago; W. M. Mackay, New York; and D. D. Kimball, New York.

This session, which was attended by the ladies, as well as by the members, partook of a popular nature by the delivery of two lectures illustrated by the stereopticon, one on "Safety Devices," by Dr. William H. Tolman, director of the American Museum of Safety and the other on "The Development of the Modern Skyscraper," by President Reginald Pelham Bolton. The gathering was further entertained by the display of moving picture films.



PROF. JOHN R. ALLEN
President American Society of Heating and Ventilating Engineers

Afternoon Session, January 24

This session was devoted to a discussion of ventilation. Following the report of the committee on schoolroom ventilation, appointed to act in conjunction with a similar committee of the American Association or Hygiene, presented by the chairman, Frank Irving Cooper, a paper on "Ventilation Questions" was read by D. D. Kimball. This was followed by papers on "Dust in Relation to Health," by Konrad Meier; "Effect of Humidity and Means for Control," by J. I. Lyle; and on "Chemical Notes on Ventilation," by Percy Norton Evans. A presentation of the work of the Chicago Ventilating Commission was sent in by Sam R. Lewis, of Chicago.

The meeting was then addressed by Dr. W. Gilman Thompson, professor of medicine at Cornell University; Dr. C. E. A. Winslow, associate professor of biology, College of the City of New York and curator of public health, Museum of Natural History, New York; Dr. James H. McCurdy, director International Y. M. C. A. Training School, Springfield, Mass.; Dr. C. Ward Crampton, director of physical training, New York Public Schools; Dr. T. S. Carrington, assistant secretary, National Association for the study and Prevention of Tuberculosis; Dr. Luther H. Gulick, director, department of child hygiene, Russell Sage Foundation; Mrs. Stephen S. Wise, who has made investigations of conditions in New York's schools; Dr. Henry Mitchell Smith, of Brooklyn; Mr. Bass, engineer of the Minnesota State Board of Health; and Frank G. McGann, chief engineer for the New York Department of Education.

Morning Session, January 25

Papers were read at this session on "Steam Heating Large Department Stores; Its Relation to Their Electrical Requirements," by David S. Boyden, Boston; "Hot Water Heating by

Forced Circulation," by Ira N. Evans; "Auxiliaries for Pressure Systems of Hot Water Heating," by J. J. Wilson, Philadelphia; "Steam Heating from the Receiver of a Compound Engine," by Auguste Baurrienne, secretary of the Association des Ingenieurs de Chauffage et de Ventilation de France; and "Ventilating a Steam Laundry," by A. M. Feldman, New York.

Frank G. McCann discussed the criticisms leveled at the Board of Education in connection with poorly-ventilated schools.

Frank T. Chapman, chairman of the New York Chapter's committee on the ventilation of moving picture shows, presented a report containing the commitee's ideas of a proposed ordinance embodying the necessary requirements.

Prof. William Kent read a report on proposed standards for flanges and flanged fittings which was compiled by committees of the American Society of Mechanical Engineers and the National Association of Master Steam and Hot Water Fitters. Its features were recommended for adoption by members of the society.

Afternoon Session, January 25

The final session was taken up with papers on "Heat Transmission with Indirect Radiation," by Frank L. Busey, Buffalo; "Tests of Vacuum Cleaning Tools and Exhausters," by M. S. Cooley, Washington, D. C.; and "Heating a Swimming Pool," by Cesar Teran.

An additional subject for discussion was "Efficiency as Applied to the Heating Industry," which was opened by Norman A. Hill, Baltimore.

It was at this session that the resolution was passed that the operation of the mechanical plants in New York public schools be placed under the jurisdiction of those designing such plants.

Changes in the society's constitution were then approved, for submission to the members for mail ballot, providing for the appointment of the secretary by the board of governors and giving the meeting the power to instruct the board.

The retiring president then called First Vice-President John F. Hale to the chair in the absence of President John R. Allen, who is in Constantinople, Tnrkey, supervising the organization of a school of engineering at that point. It is probable that Prof. Allen will be absent for a great part, if not all, of his term of office, so that Mr. Hale will be acting president of the society during the coming year.

The Entertainment

Features of the entertainment were an inspection of the Chelsea docks and of the Cunard Line steamer Carmania, on the morning of January 24. Though the efforts of Thomas Barwick, who had charge of the party, an opportunity was given to see the engine room of the steamer. At the same time another party was being conducted through the New York Public Library by Melvern F. Thomas. After luncheon, which was served at the Priscilla tea rooms, two matinée parties were formed for the ladies, the attractions being "Kismet" at the Knickerbocker Theatre and "The Quaker Girl" at the Park Theatre.

In the evening the society's annual dinner was served in the Peacock room, Murray's Restaurant. The dinner was enlivened by a negro quartette, which entertained the company with songs and instrumental music. President Reginald Pelham Bolton acted as toastmaster and introduced Miss Helen Varick Boswell, chairman Industrial and Social Conditions Department of the General Federation of Women's Clubs. Miss Boswell stated that there are 7,000,000 workwomen in the industries in the United States, and that no one thing so affected their health as poor ventilation. She hoped the housing problem would be so solved that they would have the same privileges for health as the wealthy. She bespoke the interest of the society in this direction, and likened it to a public service commission.

Dr. Luther H. Gulick, director of the Department of Child Hygiene, Russell Sage Foundation, who was the next speaker, stated that an inspection of the New York public schools had shown that the percentage of promotions was 3% greater in well-ventilated than in poorly ventilated schools. The annual cost of educating one child is $40, and where a pupil has to repeat a difference of 3% in promotions means an annual expense of $930,000. Dr. Luther said that the ideal of ventilation is recirculation of air, on the lines of the recirculation of water. "We have found out," he said, "the

ANNUAL DINNER OF AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS AT MURRAY'S RESTAURANT, NEW YORK

difference between sewage and good water. When we know as much about air as we do about water and about the transmutation of food, we will be able to so purify air that it may be used over and over again."

Auguste Baurrienne, secretary of the Association des Ingenieurs de Chauffage et de Ventilation de France, spoke for a closer coöperation between the French and American societies. M. Beaurrienne's remarks were warmly applauded and Toastmaster Bolton expressed the general sentiment when he extended a cordial welcome to M. Beaurrienne and hoped that the American society would soon be represented at a meeting of the French heating engineers.

Other speakers were Theodore Weinshank, who spoke of his visit to England last year, where he was a guest of the (British) Institution of Heating and Ventilating Engineers on the occasion of their mid-winter meeting; First Vice-President John F. Hale and J. W. H. Myrick.

On Thursday, January 25, the ladies were taken to the Tiffany Studios on 37th street, and, after luncheon, formed an automobile party, being taken through Central Park and along Riverside Drive. On their return they were entertained at tea at the Waldorf-Astoria Hotel. A full day was capped in the evening with a Hippodrome party, including both members and guests.

The entertainment arrangements were successfully carried out by the New York Chapter's Committee on Annual Meeting: D. D. Kimball, chairman, Thomas Barwick, M. F. Thomas, Conway Kiewitz, E. E. Fox, R. P. Bolton, W. W. Macon, Frank T. Chapman and W. G. LeCompte. The ladies' committee was composed of Mrs. Reginald Pelham Bolton, Mrs. von Rehm, Mrs. William W. Macon, Mrs. Thomas Barwick, Mrs. Frank T. Chapman, Mrs. C. B. J. Snyder, Mrs. Percival H. Seward, Mrs. James A. Donnelly, Mrs. C. E. Pearce, Mrs. Arthur Stowell Armagnac and Mrs. Melvern F. Thomas.

For a Massachusetts Chapter

Temporary organization of a Massachusetts Chapter of The American Society of Heating and Ventilating Engineers was effected during the society's recent meeting in New York, with the election of the following officers: Temporary president, H. W. Whitten; temporary secretary, David S. Boyden, committee on constitution and by-laws, W. T. Smallmann and Charles Morrison; committee on nomination of officers, A. B. Franklin, J. A. Moore and J. W. H. Myrick. The meeting for permanent organization was to be held in Boston, February 8, at the office of Frederick Irving Cooper. Fifteen names were attached to the petition asking for a separate chapter.

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THE HEATING ENGINEERS struck a live note at their annual meeting when they adopted their resolution recommending that the operation of heating and ventilating plants in New York City's public schools (although they might have applied it with equal force to other cities and to other classes of buildings) be placed in the hands of the department that designed them. Much of the recent criticism of poorly ventilated school rooms intimates that not only is the fault with the designing engineer but that he is peculiarly obtuse, not to say stubborn, in failing to see the failure of his fine-spun theories and methods. In short, he is looked upon in many quarters as an obstacle in the path of the progressive ventilation enthusiasts and it was high time that the criticisms be sifted down to a basis of fact and analyzed.

Speaking of the public school buildings in New York City alone, it appears that the engineering department has no control of the operation of the plants whatsoever. As a result, such conditions are frequently found as doors provided for cleaning ducts being left wide open and many similar practices, sufficient in every case to throw the system out of gear. President Bolton showed that the abuse of heating and ventilating plants was not confined to schools and hospitals by describing the conditions of the apparatus in such prominent buildings as the Tombs prison in New York and in the New York Hall of Records. In the case of the Tombs, the expensive fan system has never been used, a fact discovered after complaints had been made of the foul air in portions of the building. The only fans in operation in the Hall of Records were found to be those in the vent openings in the roof. Moreover, the air inlets at the street level were not even protected by screens, with the result that the quantities of street dust that drifted into the building were a source of annoyance and mystery to the occupants.

The profession may well ask itself, what is the use of developing a finely-balanced ventilating system when it is practically certain that it will be operated, if at all, with a degree of carelessness limited only by the ignorance or "pull" of the man in charge? It is a pity that such facts as those just quoted can not be given the same prominence in the daily press as were given the country-wide comments that have been going the rounds. But it is not yet too late. The resolution referred to, which is printed on another page of this issue, rings true and comes pretty close to the root of most ventilation troubles. It should have a very decided effect in exposing the real situation and in providing the basis for a remedy.

MECHANICAL EQUIPMENT

Tests of Vacuum Cleaning Tools and Exhausters*

By M. S. Cooley.

The tests described below were made by the author three years ago and were primarily to determine:

1.—The feasibility of using a carpet cleaning test to determine the merits of a vacuum cleaning system.

2.—To fix the requirements to be incorporated in a specification, where acceptance of the system was dependent on a satisfactory cleaning test.

3.—To determine what requirements, rather than a cleaning test, would be necessary to obtain a first-class cleaning system.

In making carpet cleaning tests, three types of carpet renovators were used, referred to as types A, B and C, in the order in which tests were made. Sections of these renovators are shown in the illustrations, and they may be briefly described as follows:

Type A: This renovator has a cleaning slot 5-16 in. wide and 12 in. long in communication with a second slot, open to atmosphere through an opening under the dividing partition which stands 1-32 in. above the working face of the tool.

Type B: This renovator has a cleaning slot 1-8 in. wide and 12 in. long, with no openings for admission of air other than the cleaning slot.

Type C: This renovator has a cleaning slot 3-4 in wide and 10 in. long, with no openings for admission of air other than the cleaning slot.

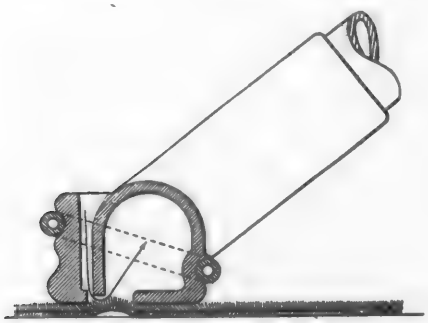


Fig. 1—TYPE A CARPET RENOVATOR

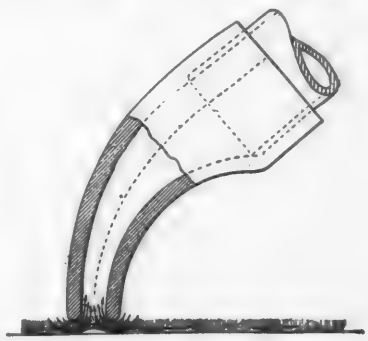


Fig. 2—TYPE B CARPET RENOVATOR

In the first test made at Philadelphia a glue sized brussels carpet, which had been in use for many years, was divided into three equal parts and each one cleaned for 6 min., using a

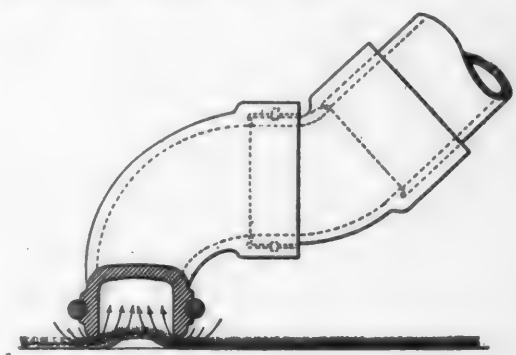


Fig. 3—TYPE C. CARPET RENOVATOR

*Presented at the annual meeting of the American Society of Heating and Ventilating Engineers, New York, January 23-25, 1912.

type A renovator. The vacuum at the tool handle varied for each carpet. Indicator cards were taken for the vacuum pump during each test and the number of cubic feet of air calculated therefrom. At the conclusion of these tests each carpet was cleaned until no change in weight occurred after 2 min. cleaning. They were then considered clean. Carpets were weighed to ¼ oz. in all cases. The result of the test is given in Table I.

TABLE I—TEST WITH RENOVATING TOOL A, SHOWING DIRT REMOVAL, PER CENT. OF TOTAL

Time, Minutes	Vacuum at Handle, Inches		
	1	2½	4
1	37	39	47
2	52	50	63
3	59	66	71
4	61	72	83
5	66	75	87
6	67	82	90
	Air, Cubic Feet per Minute		
	30	43	50

Each of the carpets measured approximately 7 sq. yds. and contained when received approximately 12 oz. of dirt.

An attempt was then made to obtain some substance within which carpets could be artificially soiled, which would be as difficult in removal as dirt ground in by usage. The results were far from successful and no substance was found that was nearly equal to a soiled carpet. The following were tried on the same carpets used in the first test:

Wheat flour was very easily and completely removed, as much as 3 lbs. being completely removed in 3 min. with 3-in. vacuum at handle.

Portland cement: 95% was removed in 2 min. with 1 in. vacuum at the handle.

Moulders' sand: 100% was removed in 3 min. with 2½ in. at the tool handle.

Carpet was covered with wet mud and then dried: 100% was removed in 3 min. with 2½-in. vacuum at the tool handle.

Finally, dry, sharp builders' sand, screened through a 50-mesh screen, was used and found to be most satisfactory, and tests were run as summarized in Table II.

TABLE II—TEST OF REMOVAL OF BUILDERS' SAND WITH TOOL A, PER CENT. OF TOTAL

Time, Minutes	Vacuum at Handle, Inches		
	1	2½	4
1	45	61	50
2	60.5	75	75
3	73.5	84	77
4	76.3	91	88
5	....	94.5	97
6	....	....	100
	Air, Cubic Feet per Minute		
	30	43	50

When carpets were artificially soiled, the manner of making tests was as follows: a carpet of known area was cleaned until no change in weight occurred in two minutes' cleaning, and then weighed to nearest quarter ounce. Material was then sprinkled on the carpet and worked in with the feet until none of it could be seen on the surface of the carpet. The carpet was then weighed again, fastened down, and cleaned for a predetermined interval of time, and the carpet again weighed. This procedure was repeated until all dirt was removed.

It was found that in rolling carpet, to weigh it after filling with dirt, some of the material was shaken loose. After a few trials, weighing the carpet before filling, weighing the material before placing, and weighing the carpet after filling, it was found that no measurable loss of material occurred in working it in. In subsequent tests, the carpet was weighed clean and fastened down and the material weighed and worked in with a considerable saving of time.

It being considered advisable to make cleaning tests with other types

of renovators, a renovator of type B, the only other type of renovator available in Philadelphia, was obtained, and as no more dirty carpets were available, tests with dry, sharp sand were run on the same carpets as before, using type B renovator, with results given in Table III.

TABLE III—TEST OF REMOVAL OF BUILDERS' SAND FROM CARPET, WITH TOOL B, PER CENT. OF TOTAL

Time, Minutes	Vacuum at Tool Handle, Inches	
	2	4½
1	48	54
2	70	87
3	91	100
4	100	...
	Air, Cubic Feet per Minute	
	24.5	39.5

Shortly after making these tests the author was afforded the opportunity to test a renovator of type C. However, the exhauster available would not produce a vacuum of more than 6 in. of mercury and this vacuum could not be readily controlled. Therefore all tests were made with 3½. in of vacuum at the tool handle. Tests were run on a dirty carpet containing 4 sq. yds., and when received approximately 6 oz. of dust and also on carpets filled with sand with the results given in Table IV.

TABLE IV—TESTED WITH RENOVATOR OF TYPE C

Time, Minutes	Dirt Removed, Per Cent. of Total	Sand Removed, Per Cent. of Total
1	40	68
2	60	82
3	90	100
	Air, Cubic Feet per Minute	
	66	66

Taking results from all these tests with a vacuum at handle of 3½ to 4½ in., the number of cubic feet of air required to remove 1 oz. of sand with the three types of cleansers is: type A, 50 cu. ft.; type B, 17 cu. ft.; type C, 22 cu. ft.

This is with carpets containing approximately 1 oz. of sand per square yard of carpet, which was the maximum that could be rubbed into the carpet used at Philadelphia, and from tests on dirty carpets this is approximately 70% of the amount of dirt we would find in a very dirty carpet.

Having at hand the thesis of Mr. Stewart R. Miller, of the Massachusetts Institute of Technology, in which he reported tests on type A and B renovators, removing 5½ oz. of dust per yard of carpet, a long-fibred carpet was obtained and tested, using type C renovator with the carpet filled at the rate of 5½ oz. of dust per yard. Making deductions from tests made by the author, he approximated the number of cubic feet of air exhausted in the Massachusetts tests and ascertained the number of cubic feet of air per ounce of sand removed to be as follows: type A 17.5 cu. ft.; type B, 10.9 cu. ft.; type C, 12.5 cu. ft.

EFFORT REQUIRED TO MOVE VACUUM CLEANING TOOLS, OPERATING WITH DIFFERENT DEGREES OF VACUUM

In order to determine what effect the degree of vacuum at the tool handle had on the effort necessary to move the renovators over the floor, the various types of renovators were operated over various surfaces and were pulled along, using a spring balance, the pull registered being noted with the results enumerated in Table V.

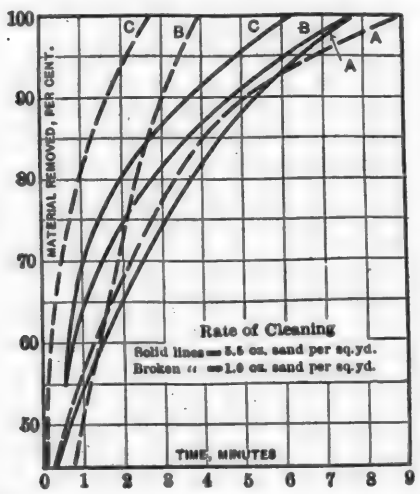
The results are shown graphically in Figs. 4 and 5. Fig. 4 shows the rate of cleaning with the three types of renovators and Fig. 5 shows the number of cubic feet of free air per minute used during the tests.

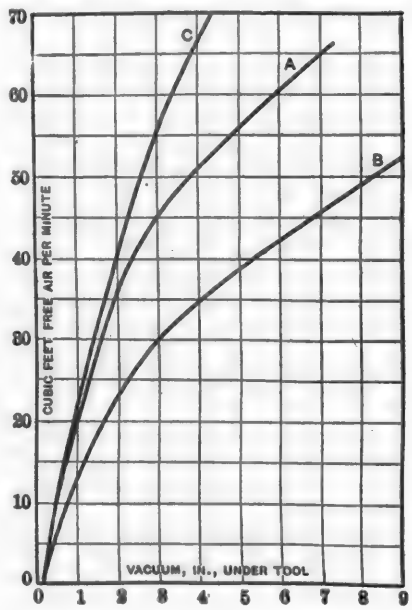
An analysis of tests shows that in order to clean a carpet effectively, we must have some degree of vacuum under the tool itself. Merely a current of air is not all that is required.

TABLE V—TESTS OF EFFORT REQUIRED TO MOVE VACUUM CLEANING TOOLS

	Type Surface	Vacuum, Inches	Pull, Pounds	Air, Cubic Feet
A	Velvet carpet, glue back	6½	17	45
A	Velvet carpet, no glue back	1	12	56
A	Brussels carpet, glue back	6½	17	45
A	Linoleum	1	10	56
B	Velvet carpet, glue back	8½	18	35
B	Velvet carpet, no glue back	3½	15	50
B	Brussels carpet, glue back	8	20	39
B	Linoleum	13	23	20
C	Brussels, glue back	3½	11	66
C	Axminster	3½	13	66
C	Linoleum	4½	13	60

For example, note that with type A renovator with 30 cu. ft. of air passing and 1 in. of vacuum under the renovator but 76% of the sand was removed in 4 minutes. With type B renovator, with 24.5 cu. ft. of air passing and 2 in. of vacuum under the





FIGS. 4 and 5—TESTS OF EFFORTS REQUIRED TO MOVE VACUUM CLEANING TOOLS

tool, 100% of the sand was removed in 4 min. On dirty carpets the result is even more marked. Apparently when working on a dirty carpet, it is the vacuum that loosens the dust from the carpet, the air acting as the conveying medium for removing the dirt loosened by the vacuum.

For rapid, thorough and effective cleaning of carpets and other fabrics of equal weight and thickness the author considers that a vacuum of at least 3½ in. at the tool handle is necessary. It is also evident that a vacuum very much higher than 4 in. or 5 in. will cause the tool to stick and be hard to operate, and will be likely to cause undue wear on the carpets.

It is also evident from the last column of Table V that the number of cubic feet of free air passing through the same renovator varies with the character of the surface cleaned. This characteristic is more marked with the type A renovator and is accounted for by the effect of the inrush slot or vacuum breaker.

Comparing the efficiency of these renovators as dust removers, type B

is more efficient than type C, and both are vastly more efficient than type A. This can be accounted for by the construction of type A renovator, which received the bulk of its air under the partition between the cleaning and the inrush slot, while both of the other types receive air under both sides of the cleaning slot as indicated by the arrows in Figs. 2 and 3. Therefore type A renovator cleans on one side only, while the other types clean on both sides. Further, much of the air passing under the dividing partition of type A renovator passes directly to the outlet without penetrating the nap of the carpet.

In actual carpet cleaning, we have to pick up and remove, besides the dust, matches, cigar and cigarette stumps, bits of paper and other small litter, which are obviously too large to pass the narrow slot of type B renovator. Therefore, the ideal system would be one using type C renovator and arranged to maintain a constant vacuum of 3½ in. to 4 in. at the handle, irrespective of the quantity of air passing.

The control of the vacuum at the vacuum produced with varying quantities of air passing is a simple matter. However, there are other elements in a complete system between the renovator and the vacuum producer which affect the control of the vacuum at the renovator. These are the hose, pipe lines and dust separators.

Fig. 6 shows the results of actual tests of the friction loss in cleaning hose of 1, 1¼, 1½ and 2 in. diameter. The effect of friction in 1-in. hose is also shown in tests with the spring balance. In all tests of type A and B renovators 100 ft. of 1-in. hose was used and 15 in. of vacuum was maintained at the hose cock. We see that

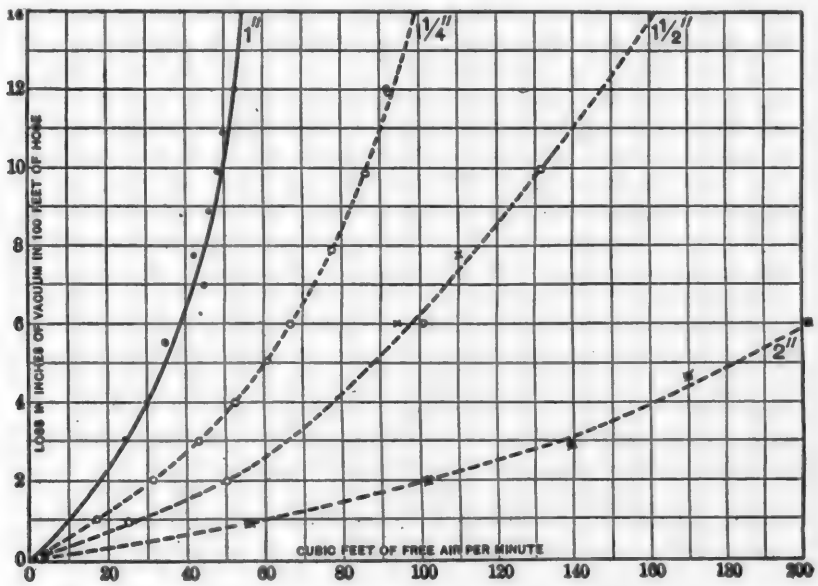


FIG. 6—RESULTS OF TESTS OF FRICTION LOSS IN CLEANING HOSE

with the vacuum at hose cock maintained at 15 in., the vacuum at the tool handle varied from 1 to 13 in., due to the variation in the quantity of air passing into the renovators when operated on various surfaces.

It is also noted that while the vacuum at the handle varied from 3½ to 13 in. with type B renovator, with type A renovator a variation of 1 to 6½ in. was obtained, operating over the same surfaces. This condition is due to the effect of the inrush slot which acts as a vacuum breaker when the renovator is operated on smooth surfaces or dense fabrics, and thus prevents the sticking of the renovator. This, however, is obtained only at a sacrifice in cleaning efficiency of the

renovator as the leakage or by-pass effect of the inrush slot is always present. Better results can be obtained by using type B renovator, placing a spring-actuated vacuum breaker in the tool handle set to open at 5 or 6 in. of vacuum.

Much better results, however, can be obtained by using type B or C renovators in connection with 1½ in. hose. In this way the total variation in vacuum, when operating on various kinds of surface will not exceed 1 in. for type B renovator, nor 1½ in. for type C renovator, and without recourse to any type of vacuum breaker in the renovator or tool handle and with a consequent saving in the power expended.

Pipe lines add their friction effect to that of the hose lines, but in a far less marked degree, as they are seldom made less than 2 in. in diameter. With a system so designed that the producer maintaining a constant vacuum of 6 in. a good control of the vacuum at the handle will be had without the use of any vacuum breakers. In designing pipe lines, care must be exercised that the velocity in these lines never falls below 2,500 ft. per minute, or dust will be deposited in the pipe lines.

The tests show that with a carpet cleaning test as the only requirement, one may expect to get a system using type B renovators, 1-in. hose, small pipe lines, a movement of air of approximately 25 cu. ft. per renovator, a vacuum at exhauster of about 10 in. and a small vacuum producer. While this system will meet the carpet-cleaning test, it will not pick up ordinary litter, and when used for cleaning bare floors, relief work and the like will be ineffective, due to the small volume of air which is the essential quality for this character of work.

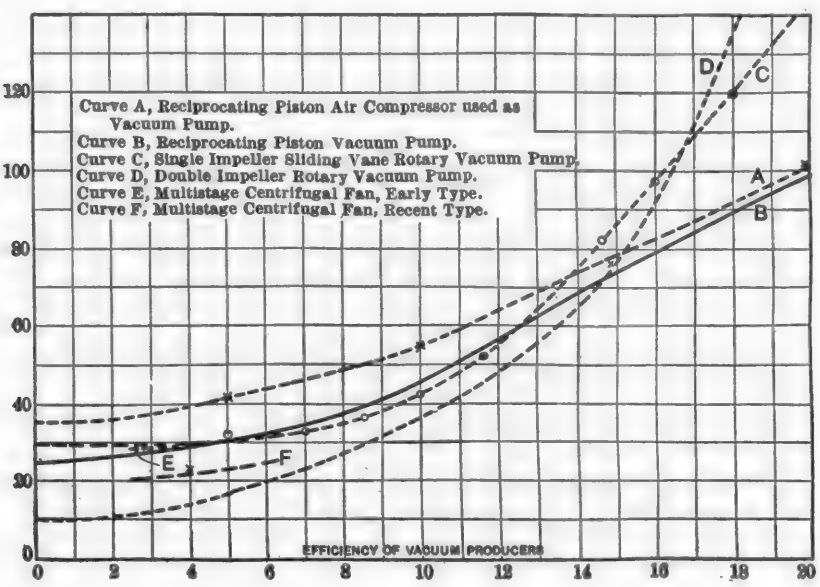


FIG. 7—POWER CONSUMPTION OF SIX DIFFERENT TYPES OF VACUUM PRODUCERS. ORDINATES SHOW THE POWER CONSUMPTION OF MOTOR IN WATTS PER CUBIC FOOT OF FREE AIR EXHAUSTED PER MINUTE

maximum length of hose necessary will not exceed 75 ft., and with the 1½ in. diameter hose and ample sized pipe lines, the maximum loss in vacuum between the tool handle and the vacuum producer will not exceed 3 in. With this system and a vacuum

I consider that to obtain the best results in a cleaning system, the width of cleaning slot should be required to be not less than ½ in.; the length of the renovator not less than 12 in.; the diameter of the hose 1½ in.; that the pipe lines should be not

less than 2½ in. in diameter, except where lifts occur, where 2 in. should be used; that the vacuum control be set to maintain 6 or 7 in. of vacuum at the machine.

SUGGESTED ARRANGEMENT FOR TESTING

The following test is suggested to give the best results: Fit a 1½-in. diameter pipe 3 ft. long into the end of the hose, with a diaphragm at the outer end and a vacuum gauge mercury column near the hose. Require a vacuum at mercury column of 3 in. with 65 cu. ft. of air passing into the tube, and as many hose lines and tubes in operation as the capacity in sweepers desired. This test will acquire approximately a ⅝ in. diameter opening in the diaphragms.

VACUUM PRODUCERS

Fig. 7 shows curves of power consumption of six different types of vacuum producers based on tests made by the author. Curve A is from a reciprocating piston air compressor used as a vacuum pump. Curve B is from a reciprocating piston vacuum pump especially designed for vacuum cleaning and shows a higher economy than A. Curve C is from a single impeller sliding vane rotary vacuum pump and shows equal economy to B up to 12 in. of vacuum, above which its efficiency falls off. Curve D is from a double impeller rotary vacuum pump, water sealed, which shows much better economy than B below 14½ in. of vacuum. Curve E is from an early type of multi-stage centrifugal fan and shows an efficiency about equal to B and C. Curve F is from a recent type of multi-stage centrifugal fan and shows an efficiency better than any except D.

At 6 in. of vacuum these vacuum producers can be rated in the following order, relative to efficiency: 1, D; 2, F; 3, B; 4, E; 5, C; 6, A. D will require a vacuum control in actual operation, which control should preferably be of variable speed type, while type F maintains a constant vacuum due to inherent properties of its construction, and where first cost is of vital consideration its use might be preferable to D. Both D and F are subject to considerable noise and vibration, unless the peripheral velocities of fans and impellors are limited. The author recommends a maximum velocity of tips of impellors of 1,100 ft. per minute in D and over 1,500 ft. per minute in F.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

AIR COOLING

Cooling Air of Buildings by Mechanical Refrigeration. E. F. Tweedy. Explains principles and gives a practical application. 3000 w. Power. Nov. 28, 1911. 20c.

DUST EXTRACTORS

Mechanical Appliances for Dust Extraction in Cotton Mills. H. M. Crawford. Illustrated description of appliances and Methods of obtaining cleanliness in cotton manufacture and clearing the atmosphere of the card room. 2500 w. Cassier's Mag. Nov., 1911. 40c.

HEAT FLOW THROUGH BODIES

Flow of Heat Through Bodies. Carl Hering. Gives an extended table of thermal resistivities, compiled from various sources. 3000 w. Met. and Chem. Eng. Dec., 1911. 40c.

HEATING PLANT, NEW YORK PUBLIC LIBRARY

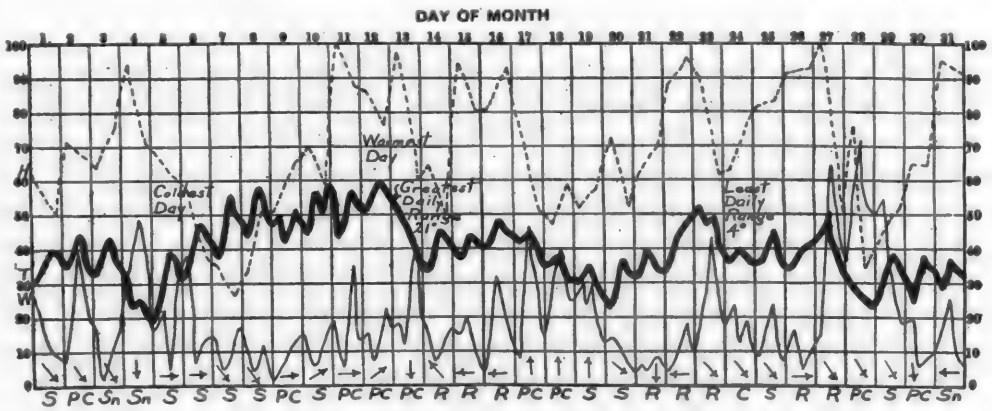
Heating Plant of the New York Public Library. A. D. Blake. 2000 w. 7 figs. Power. Dec. 5, 1911. 20c.

Bankrupt Contractor's Trustee's Right to Recover Contract Price

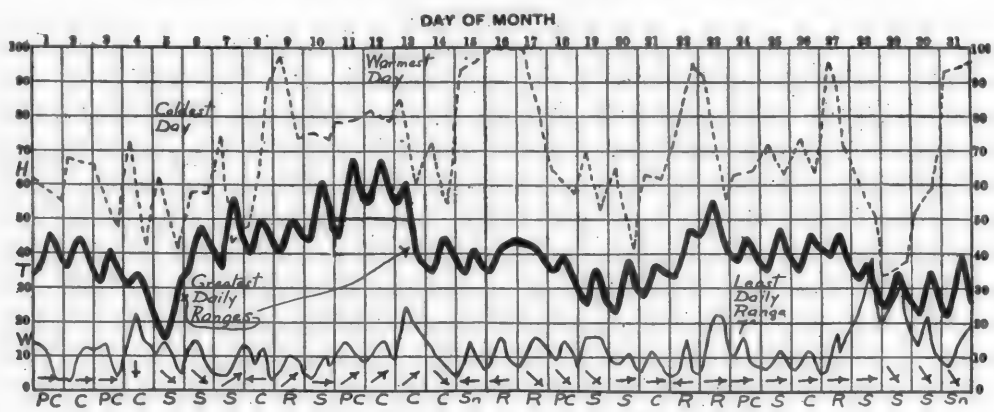
The contractor for the heating and plumbing of a public school building having become bankrupt, his trustee completed the work. It was held that he was entitled to receive the balance due under the contract as provided by the bankruptcy act, and it was not material to the obligation of the board of education to pay the trustee that persons claiming as subcontractors and materialmen for labor and material had filed claims therefor both with the board and in the bankruptcy proceedings; they having asserted no claim in proceedings by the trustee to recover the fund.—Ford vs. State Board of Education, Michigan Supreme Court.

The Weather for December, 1911

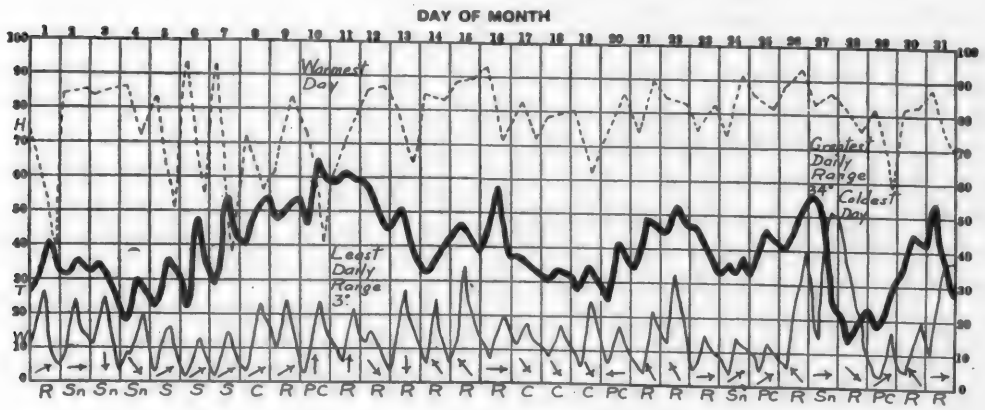
	New York	Boston	Pittsburg	Chicago	St. Louis
Highest temperature, degrees F	60	68	66	60	65
Date of Highest temperature	12	12	10	10	10
Lowest temperature, degrees F	18	15	14	5	12
Date of lowest temperature	5	5	28	28	31
Greatest daily range, degrees F	21	24	34	27	23
Date of greatest daily range	13	13	27	31	31
Least daily range, degrees F	4	7	3	3	3
Date of least daily range	24	24	11	9	16
Mean temp. for month, degrees F	39.2	39	39	35	38
Normal mean temp. for month, deg. F.	34.4	31.6	34.7	29.3	35.5
Total rainfall, inches	3.39	3.07	3.79	2.54	1.67
Total snowfall, inches	7.3	1.49	7.9	7.8	2.6
Normal precipitation, this month, inches.	3.45	3.07	2.73	2.07	2.23
Total wind movement, miles	12309	7900	8190	10726	7930
Average hourly wind velocity, miles	16.5	10.6	11	14.4	10.7
Prevailing direction of wind	N. W.	W.	S. W.	S. W.	S.
Number of clear days	9	10	4	8	6
Number of partly cloudy days	8	6	7	9	6
Number of cloudy days	14	15	20	14	19
Number of days on which rain fell	15	8	19	10	12
Number of days on which snow fell	3	2	5	8	.....
Snow on ground at end of month, ins.	None	1.8	None	0.6	Trace



RECORD OF THE WEATHER IN NEW YORK FOR DECEMBER, 1911.



RECORD OF THE WEATHER IN BOSTON FOR DECEMBER, 1911


DAY OF MONTH
Warmest Day
Least Daily Range 3°
Greatest Daily Range 34°
Coldest Day
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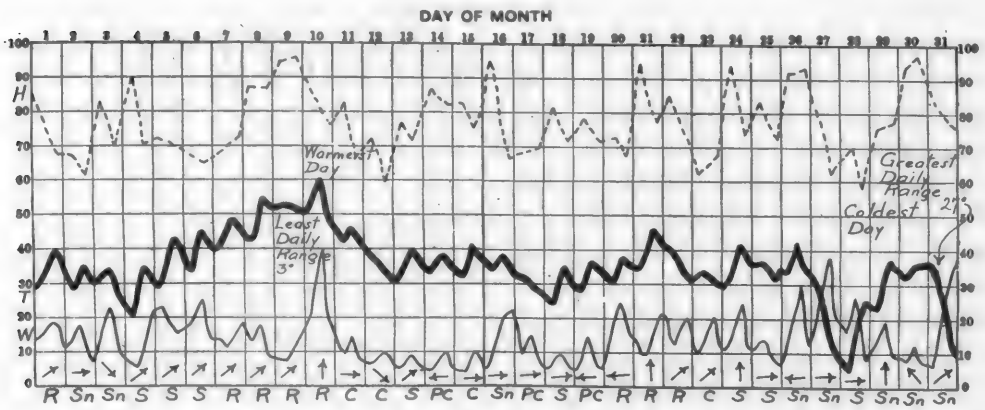
RECORD OF THE WEATHER IN PITTSBURG FOR DECEMBER, 1911


DAY OF MONTH
Warmest Day
Least Daily Range 3°
Greatest Daily Range 27°
Coldest Day
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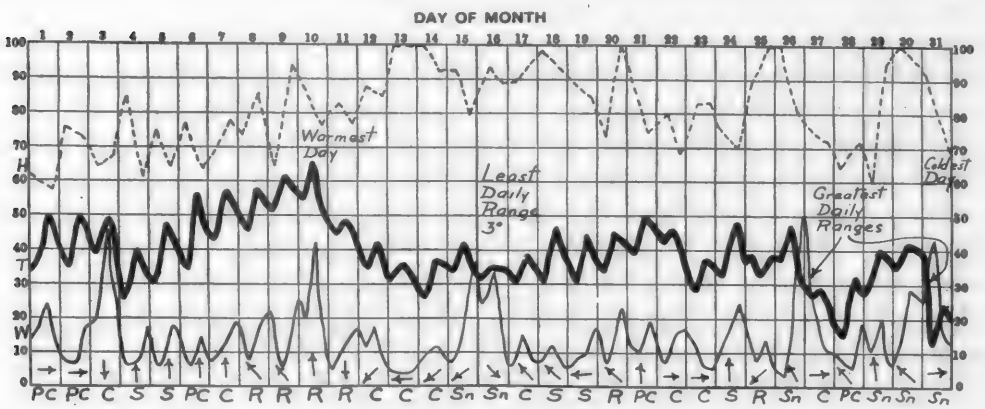
RECORD OF THE WEATHER IN CHICAGO FOR DECEMBER, 1911


DAY OF MONTH
Warmest Day
Least Daily Range 3°
Greatest Daily Ranges
Coldest Day
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RECORD OF THE WEATHER IN ST. LOUIS FOR DECEMBER, 1911

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate humidity in percentage from readings taken at 8 A.M. and 8 P.M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New York Chapter's Recommendations for Compulsory Ventilation of Moving Picture Shows

The committee, from a practical standpoint, rather than from an ideal standpoint, advances the following recommendations:

Floor Area Per Occupant.—A minimum of 5 sq. ft. of floor space per occupant, exclusive of passageways, shall be provided in the audience hall.

Cubic Space Per Occupant.—A minimum of 90 cu. ft. of air space per occupant shall be provided in the audience hall.

Quantity of Outdoor Air.—A positive supply of outdoor air from an uncontaminated source shall be provided the audience hall at all times while the show place is open to the public, and the quantity of this positive supply of outdoor air shall be based on a minimum requirement of 20 cu. ' . per minute per occupant.

Temperature.—The temperature of the air in the audience hall shall be maintained throughout at the breathing line (persons being seated) within the range of 65° F. to 70° F., and the temperature, distribution and diffusion of the supplied outdoor air shall be such as to maintain this result without uncomfortable draughts.

Direct Heat Sources.—Any good heat source which does not contaminate the air, will be accepted to supplement the warmed outdoor air supply. Gas heaters or coal stoves are prohibited.

Machine Booth Ventilation. — Enclosures or booths for the motion picture machines shall be provided with special exhaust ventilation positively changing the air in the booth at least six times per hour, and being entirely independent from any exhaust ventilation of the audience hall. This ventilation shall consist of a number of small metal-screened openings near the bottom of the booth, and a metal or other fireproof flue (size not less than 15 in. in diameter) extending from top of booth and carried to proper place of discharge outdoors and augmented by mechanical appliance or otherwise to secure the results herein stated.

General questions, such as inspection, method of enforcing the requirements, penalties for noncompliance, etc., are left for each town or city to determine.

New Members

The election of the following new members is announced:

P. L. Davis, 1200 Michigan avenue, Chicago, Ill.

Edward Ehshley, Jr., 527 Fifth avenue, New York, N. Y.

Wallace F. Goodnow, 104 West Forty-second street, New York.

H. M. Hart, 338 South Sherman street, Chicago, Ill.

Richard B. Hunt, 12 E. Forty-second street, New York, N. Y.

R. B. Mackinnon, Pease Foundry Co., Ltd., Toronto, Ont.

Wm. J. Olvany, 177 Christopher street, New York, N. Y.

O. M. Row, Irlam, Manchester, England.

E. J. Treat, 119 W. Seventy-second street, New York, N. Y.

Associate Members

Charles J. Jackson, 300 W. Lake street, Chicago, Ill.

H. B. McLelland, 300 Lake street, Chicago, Ill.

Frederick W. Smith, Shirley, Ind.

Junior Members

George G. Schmidt, 132 Nassau street, New York, N. Y.

Oliver E. Willis, 1123 B oadway, New York, N. Y.

CORRESPONDENCE

Pumps in Vacuum Heating Systems

Editor Heating and Ventilating Magazine.

The writer of the article in your January number, "Air Pumps Needed to Circulate Steam in Heating Systems," states: "the briefest sort of consideration of the operation of the pumps will convince any logically minded engineer of the fallacy of applying pumps to heating systems to induce circulation." Then he states, "any heating installation that will circulate with a vacuum pump attached to its return will operate with just as little on the steam mains without the pump as with it, if the provision is made for venting the system to relieve it of air."

His entire article clearly shows that he has only given the question "the briefest sort of consideration," or that he intentionally is attempting to deceive your readers.

With a properly constructed low-pressure vacuum heating system, steam can be readily generated at any desired temperature between 190° and 227° F., and only the amount of fuel will be consumed that is necessary to generate the amount of steam, at a low temperature, required to heat the building to any desired temperature in mild weather. Without makink any change in the system, the temperature and amount of steam can be readily raised to the point necessary to heat the building to the desired temperature in zero weather. My claims are very conservative and can be substantiated by abundant proof, and tests that I have made in the last two months show several systems working under these conditions with no unusual attention.

There is nothing new about this question. The writer or anyone that desires information on this subject will find the subject of "combined pressure and vacuum steam heating systems" quite exhaustively treated in Mr. George D. Hoffman's paper on this subject, read before the annual meeting of the American Society of Heating and Ventilating Engineers, and the discussion of this paper is found in the society's 1907 proceedings, Vol. 13.

The writer's air-line and two check-valve system is merely a fake system, the value of which he cannot show, and no experienced engineer would think of using it.

His group of school buildings in which he claims the vapor system is giving better results than the vacuum system is no proof of anything. He does not know why either system is giving the results it is, and, of course, does not attempt to explain.

His reference to the plenum ventilating system as proving the value of the pressure system compared with the vacuum system is too absurd to require an answer.

Experienced ventilating engineers use the plenum system only where this system is best suited for the requirements. They use the exhaust system and the plenum and exhaust system together for the same purpose. Often all three of these systems are used in the same building.

One of the classes of engineers to which he refers as using in plenum system only, furnished this system to ventilate the engine room of a prominent hotel on Broadway in New York City. The result is that this room is kept under a pressure, and in cold weather the temperature in the room is 130° F. It is a crime to ask men to work in a room ventilated with this kind of a system.

In another engine room in New York City having about 3000 H. P., where both the plenum and exhaust systems are used (the exhaust fans having about 25% more capacity than the plenum), the temperature is about 90° F. in summer, unless the outside temperature is higher than this, and the engineers working in this room have often remarked in hot weather that they "go down into this engine room from the street to get cooled off."

In this same building, the shipping department, cntaining 70,000 sq. ft., is in the sub-basement, where there is no natural light or ventilation. It is equipped with both the plenum and exhaust systems and the air is so pure and pleasant that the superintendent has several applications from employees in other departments in the upper stories to be transferred to this sub-basement department. If the plenum system only had been used in this shipping department or engine room they would have been uninhabitable.

In regard to your correspondent's reference to the plant in the 30,000 town which after several years of service (perhaps 30 years; he does not state) was changed from a vacuum to a pressure system, there is no evidence that the vacuum pump had anything to do with the return pipes "giving out," but anyone who knows the first principles or definition of vacuum knows that a return line vacuum pump will not do much good on a system, with leaky, worn-out return pipes, so there should be no surprise that the pump would not help this job.

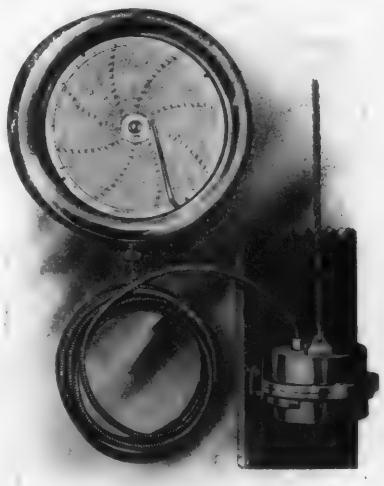
D. M. QUAY.

Cleveland, O., February, 1912.

Improved Type of Recording Liquid Level Gauge

The accompanying illustration shows a new form of recording liquid level gauge, which is designed to make continuous records in ink, on a circular chart, of the height of water or other liquids in tanks, water in reservoirs, dams, forebays, tail races, sewers, etc.

In consists of an improved round form recording gauge connected by means of



NEW TYPE OF RECORDING LIQUID LEVEL GAUGE

a small copper tube to a rubber diaphragm, which is inclosed in a brass case, the lower section of which is perforated for the admission of the liquid.

A pressure, equivalent to the depth, is exerted against the diaphragm, and this pressure is transmitted as compressed air through the connecting tube and recorded on the circular chart, which revolves once in 24 hours or seven days, as desired. The illustration of the instrument shows the compact diaphragm

movement employed for the ranges up to 20-ft. depth.

The pen arm is attached to, and supported by, a small but substantial shaft, which serves as an axis of rotation, giving ruggedness and stability for service.

The recorder is made moisture and dust tight by means of a gasket between the door and body of the case, and by cementing the glass in the door. The recorder may be located at any convenient place, the connecting tube being 100 ft. long, if necessary.

The advantage of being able to have the recorder at a point distant from the location of the bulb, and the equipment not affected by freezing temperature, will be appreciated.

These liquid level recorders are manufactured by The Industrial Instrument Co., Foxboro, Mass.

A New Development in Steam Turbines

A new type of combined impulse and reaction turbine, christened the "Spiro," has recently been put on the market, the principal features of which are illustrated herewith.

As it is of small size, and in horse power ranges from the smallest up to several hundred, it fills a gap which has long been the goal of manufacturers of existing steam turbines. The principle of its design and operation is seen from the two runners with herringbone teeth, as shown in Fig. 1. The steam impinges in the central pocket formed by the juncture of the teeth.

This turbine is the invention of John H. Van Deventer, superintendent of the Buffalo Forge Co., Buffalo, N. Y. Those closely connected with this company have for several years been anticipating the successful termination of the experiments and tests which have been known to be conducted at its plant with a view to crystallizing into a practical, matter-of-fact machine the ideas which formed the nucleus of the invention.

The construction of the turbine is simple. It consists essentially of five parts,

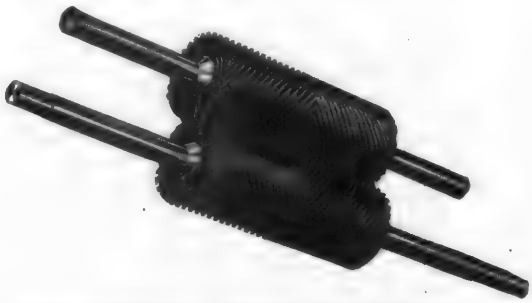


FIG. 1—"SPIRO" RUNNERS MOUNTED ON SHAFT

the case, two heads with bearings, and two rotors. These rotors consist of heliocal gears, cut by special machinery, without any loose or inserted blades. The stem action within the pockets formed by these spiral gear-teeth is theoretically perfect, making full use of the impact of the fluid due to its velocity, and avoiding the leakage usually found in turbines, which is the chief cause of their lack in mechanical efficiency.

The first impression of the "Spiro" is its extremely small size for a given power. A 186 H. P. unit has been in use for the last three years as a motive power in driving fans, gas scrubbers and other apparatus requiring a running test. It has not been apart, or had any adjustment made upon it since its installation. The stated power of this untfit, 186 H. P., was developed under 100 lbs.'

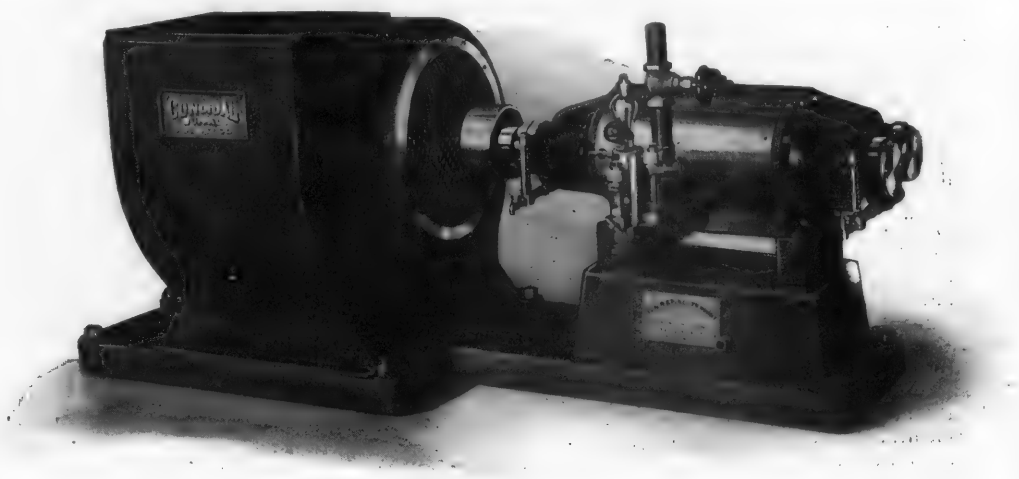


FIG. 2—25-IN. "CONOIDAL" FAN DRIVEN BY 10 H. P. SPIRO TURBINE

initial pressure. It has been decided to base the rating of all "Spiro" turbines on this pressure, in opposition to common practice among turbine manufacturers who use 150 lbs.' initial pressure as a basis. This appears to be a sensible move, as 100 lbs. unquestionably comes closer than 150 lbs. to representing the initial pressure under which small-size turbines as a rule are required to run. The latter rating, with corresponding water rates, have always been somewhat misleading.

The "Spiro" is at present manufactured in sizes from 1 to 50 H. P., noncondensing, and patterns are being completed for an extension of sizes up to 300 H. P.

It is found that in many cases where engineers would be able to make very good use of a small turbine for auxiliary work, such as induced or forced draft, driving small pumps or centrifugal blowers, and for a number of other purposes, that they are deterred from doing so by the discouraging lack of economy in small-size turbines. For them the "Spiro" will undoubtedly put a new aspect to the matter, as it has been found under test to require no more steam per horse-power hour than reciprocating engine of corresponding size.

Fig. 2 shows a 10 H. P. "Spiro" direct connected to a 25-in. fan, which is at present furnishing forced draft, through Jones underfeed stokers, to 300 boiler H. P. under severe conditions. The size of this outfit, it is stated, has never been duplicated, considering the boiler horse power served, and the fact that the highest pressure carried on the boilers is only 90 lbs.

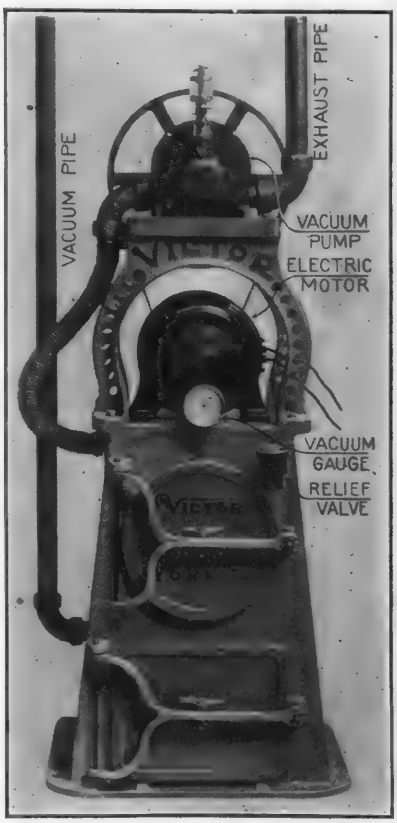
Tests made upon the "Spiro" turbine show the following results:

(1) Boiler pressure, 120 lbs.
Initial pressure, 101.5 lbs.
Horse Power, 25.3.
Speed, 2450 R. P. M.
Water per B. H. P. = 53.2 lbs. (noncondensing).

(2) Boiler pressure, 130 lbs.
Initial pressure, 115 lbs.
Horse power, 151 lbs.
Speed, 2710 R. P. M.
Water per B. H. P. = 31.8 lbs. (noncondensing).

Stationary Vacuum Cleaning Installation for a Residence

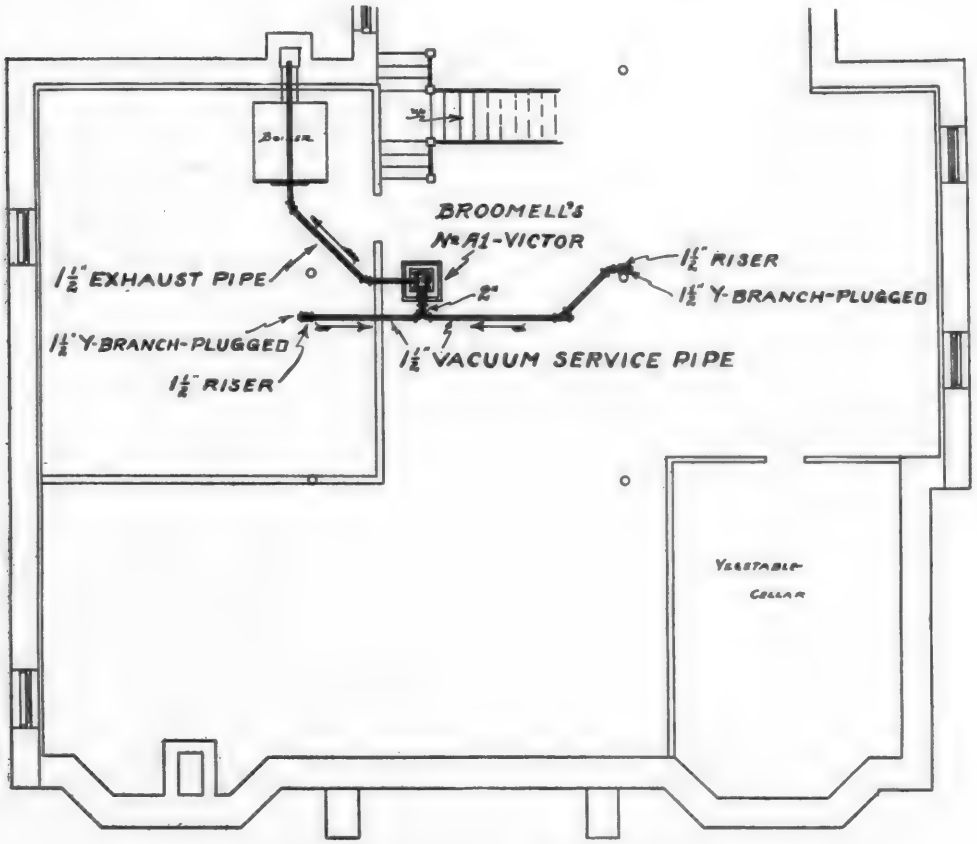
A stationary vacuum cleaning plant installed in a Brooklyn residence is shown in the accompanying illustrations. The machine used is a Victor cleaner, made by the Victor Cleaner Company, Philadelphia, Pa. The company announces that after a series of tests made by their engineers, covering a period of two years it has been found that an average vacuum of 7 in. of mercury at the machine, while the tube is being used on the carpet or rug, together with an air volume of 66 cu. ft. through a 1 in. diameter hose, and an ample vacuum chamber, together with proper sized and unobstructive vacuum



VICTOR VACUUM CLEANING MACHINE

piping, are the essential requisites to be combined for perfect cleaning.

A curious mistake was made by the steam fitter in installing this job. Although he had been given full directions for properly connecting the piping, it was found when the job was completed that the vacuum pipe was connected to the foul air exhaust, and the foul air discharge pipe was connected to the suction, resulting in an air discharge at the service inlets, insted of a suction. Thinking that the motor was rotating in the wrong direction, an electrician was called in to reverse the motor, so that a suction could be had at the service inlets. The machine was used for fully two weeks in this manner and gave excellent results, according to the owner. Fully two pecks of dirt and shavings and several dozen pins and



STATIONARY VACUUM CLEANING. INSTALLATION IN RESIDENCE

tacks were pulled through the pump, while the house was being refitted with carpets, tapestries, etc. Moveover, on taking the pump apart it was found that it had not sustained any injury.

New York Chapter's Hand Book

A souvenir hand book of the New York Chapter, American Society of Heating and Ventilating Engineers, notable for its unusually artistic design, has been published, giving an account of the formation of the chapter, together with a list of its officers and members.

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TRADE AND MISCELLANEOUS NOTES

Coming Events

Second Tuesday in Each Month—Meeting of the New York Chapter, American Society of Heating and Ventilating Engineers, Engineering Societies Building, 29 West 39th street, New York.

June 25-27, 1912—Fourth annual convention of the National District Heating Association, Detroit, Mich. Headquarters at the Cadillac Hotel.

Deaths

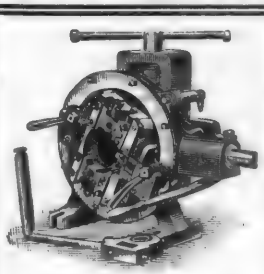
Richard T. Crane, president of Crane Company, Chicago, which he founded in 1855, and one of the most successful and best-known manufacturers of valves, fittings and other heating and plumbing supplies in the country, died at his home in Chicago, January 8, as a result of heart collapse due to a cold. Although Mr. Crane had been slightlv indisposed, his death was quite unexpected. He was 79 years old. Mr. Crane was born in Paterson, N. J., in 1832. After serving an apprenticeship in a brass and machine shop in Brooklyn, he went to Chicago in 1855 and there opened a small brass shop, which was the beginning of the house of Crane Company. Mr. Crane was a bitter enemy of institutions of higher learning, urging in their place the extension of manual training schools, many of which he founded and supported. He was one of the first to introduce the profit-sharing system in his business, and since 1900 the Crane Company has distributed over $3,000,000 among its employees on the basis of 10% of their annual earnings. The funeral services were held at Trinity Episcopal Church, Chicago, and the interment was at Lake Geneva, Wis., where Mr. Crane had his summer home. He is succeeded as president of Crane Company by Charles R. Crane. Other changes in the company's executive staff, effected at its annual meeting on January 22, are as follows: First vice-president, R. T. Crane, Jr.; second vice-president, R. T. Crane, III; treasurer, A. D. McGill; assistant treasurer, R. B. Stiles; secretary, J. B. Berryman; assistant secretary, R. W. Leatherbee; directors, C. R. Crane, R. T. Crane, Jr., R. T. Crane, III, A. D. McGill, R. B. Stiles, J. C. Kilgore, W. W. Doolittle, J. B. Berryman and R. W. Leatherbee.

Miscellaneous Notes

Judson A. Goodrich has resigned as sales manager for the Central Radiator Company, Lansdale, Pa. Mr. Goodrich has been appointed manager of the Atlantic Radiator Co., of Philadelphia, with offices at 925 Chestnut street.

Merchant Plumber and Fitter is the title of a new trade journal devoted to plumbing, heating, ventilating, lighting and vacuum cleaning, published in New York semi-monthly by the Merchant Plumbing and Fitting Company. The officers are: President and editor, W. G. McCormick; treasurer, N. McCawley; secretary and manager, W. J. Marshall; publication manager, J. H. Parker. The journal has an attractive appearance, and will no doubt prove of value to the trade.

Des Moines, Ia.—Permission to lay heating mains in the streets and alleys of Des Moines has been asked of the city counsel by the local smoker abatement commission, the purpose being to centralize the heating plants in the business district.



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NEW YORK CHICAGO

Atlanta, Ga.—The Georgia School of Technology is planning to build a central heating and lighting plant for its buildings in Atlanta; also an experimental laboratory for engineering. Piping for the plant has been donated by the National Tube Company. Professors Coon and H. P. Wood are making the design.

Oswego, N. Y.—A new heating plant is being planned for St. Paul's Church in Oswego, the Rev. Dean M. Barry, pastor.

Bolivar, Tenn.—The last session of the legislature made two appropriations for installing heating and lighting plants in the Western Hospital for the Insane at Bolivar. The work will be commenced this winter.

London, O.—The Board of Education has adopted a resolution asking for a central heating plant for the new high school building and for the remodelled central building. The cost is estimated at $20,000. The matter was to be made the subject of a special election on the question of issuing the necessary bonds.

Rock Island, Ill.—In connection with the plans for a new Manual Arts Building it is proposed to install a central heating plant for the High School, Manual Arts Building and the Lincoln Building.

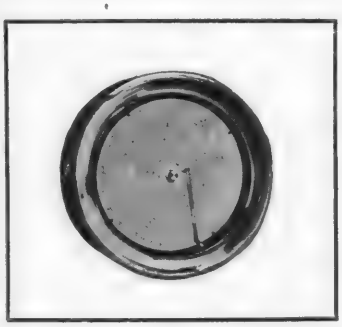
Beattie, Kan.—The city council has passed an ordinance granting to Harry D. Hockman a twenty years' franchise for the establishment and operation of an electric light, heating and power plant in Beattie. Work is to be begun at once.

Wisner, Neb.—The city has completed its central heating plant and the mains have been extended for the use of twenty-five patrons. The heat is produced at the Wisner Mills and is the first attempt in this line in the county.

Kalamazoo, Mich.—The pending applications for franchises for a central station heating plant submitted by the W. H. Schott Co., and by the Central Station Engineering Company are being held in abeyance until the city authorities can determine whether or not the city shall do its own lighting and heating.

Dayton, Ia.—Initial steps were taken at the annual meeting of the Dayton Heating and Lighting Co. to install a central heating plant in that city. A special meeting was to be held in February to definitely decide the matter.

London, Eng.—A smoke abatement



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exposition is to be held in London from March 23 to April 4 under the auspices of the Coal Smoke Abatement Society of London. The exhibits are to be classified as follows: Smokeless fuels, natural and artificial; domestic heating apparatus, furnaces and boilers used for heating rooms and buildings, including gas and electric heating appliances; testing appliances, fans and apparatus to prevent emission of dust and grit from chimneys.

Kansas City, Mo.—Recent tests of the ventilating systems in the public schools of Kansas City, conducted by Chief Engineer James H. Brady of the Board of Education and Professors F. D. Tharpe and Dr. H. DeLameter showed, in a typical class room, with the smoke test, eleven changes of air per hour. The contents of the room are 10,413 cu. ft., the amount of fresh air supplied per minute was 2,040 cu. ft., with an allowance of 40 cu. ft. per pupil per minute, based on fifty pupils to a room. In a peppermint test, the fumes being introduced in the fan room and observations being taken in the foul air outlet in the attic, it was found that the time consumed by the scent in transit was one minute and five seconds.

Automobiles are now being built with heating devices, one apparatus consisting of a radiator in the dashboard, using the heat from the exhaust from the engines. For the limousine there are various types of radiators set flush in the floor. Some open cars are provided with hand warmers, consisting of piping running along the sides.

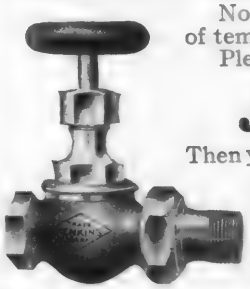
Philadelphia, Pa.—The State Board of Education has passed a rule that all old school buildings, as well as new ones, must conform to the laws regulating school house construction in matters of light, heat, ventilation, cleanliness and water supply. The application of this rule will necessitate reconstruction of many of the old school buildings, especially in rural sections.

Milwaukee, Wis.—The proposed central heating plant for the county institutions in Wauwatosa was again discussed favorably at a recent meeting of the committees on poor and insane before the county board January 9. No action was taken.

Emporia, Kan.—Work was begun January 9 on the new central heating plant for the College of Emporia. The work, which is being done by a local contractor, will cost $10,000.

Prof. James D. Hoffman delivered a lecture January 12 in the Y. M. C. A. auditorium in Omaha on "Recent Developments in Heating and Ventilation of

PERFECT SERVICE DEPENDS UPON THE VALVE



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Buildings." In outlining his lecture he said: "Our ideas have changed in the last four or five years concerning the need of pure air in our residences and business buildings. Heretofore, if the buildings were substantially built and satisfactorily heated it was considered sufficient. Lately it has been shown that about one-third of the deaths in the country has been due to 'bad air diseases,' and further, that a judicious application of pure air is not only a preventative, but a cure. These facts have led to a very great demand all over the country for improved conditions in our buildings, conditions that are being worked out at the present time in combination heating and ventilating systems, so that not only satisfactory temperatures may be maintained, but that fresh, pure air may be supplied with conditions of humidity and cleanliness that are found to be most satisfactory."

Pittsburg, Pa.—The troubles previously experienced in heating and ventilating steel cars have been overcome on the Buffalo, Rochester & Pittsburg Railway by a special design of insulation perfected by the railroad's engineers. From the floor to the window-sill the passenger is protected from the cold steel by a layer of agasote. The company's new cars have also a double steel wall and ceiling, with a lining of heavy insulating paper laid between the walls. The flooring is made of a new composition known as flexolith, which will not readly conduct heat and will not crack.

Dirt Band on Ceilings are explained in a new way by Dr. W. A. Evans, in his department in the Chicago Tribune on "How to Keep Well." In response to an inquiry as to why the ceiling of a room is striped with alternate bands of light and dark, he states: "The plastering is put on over laths. The wooden laths are better conductors of heat than the air spaces between them. Therefore, the plaster over the laths is colder than that over the spaces. The water in the air precipitates at the colder zones and the moisture catches the dirt out of the air. The dirty bands mark the location of the lath, the clean that of the spaces. The space over the radiator shows this more plainly because the hot air from the radiator flies directly to the ceiling, carrying dust and sticking it there." It has heretofore been stated that the spaces between the laths percolated dust and thus became darkened, while the spaces directly under the laths remained white.

St. Louis, Mo.—A $13,000 plant house will be added to Shaw's Garden in St. Louis. The new building will be 300 ft. long and the central portion will be 60 ft. high, 80 ft. wide and 112 ft. long. The contract price for the new greenhouse and heating plant is $123,000, and the remaining $7,000 will go for grading and other work.

Detroit, Mich.—Speaking on the subjest of ventilation, Sherman C. Kingsley, formerly superintendent of the Chicago Associated Charities, and now in charge of the Elizabeth McCormick Memorial Fund, is quoted as stating, at a recent meeting in Detroit in connection with a campaign for open air schools for tubercular children: "This is a jani-

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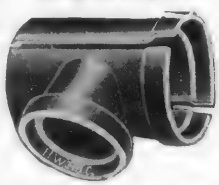
J-M Sectional Conduit



With J-M Sectional Conduit, steam, gas, water, brine, ammonia and other liquids can be conveyed underground with practically no waste or leakage. It saves over 90 per cent. of the heat that would otherwise escape through uncovered or poorly insulated pipes.

J-M Sectional Conduit is a vitrified tile conduit, salt-glazed inside and out. Chemical action of the earth, gases, acids, etc., have no effect on it. The weight or movement of pipes cannot injure it. Is permanently durable and practically indestructible.

J-M Conduit is divided in duplicate-numbered upper and lower sections, so pipes can be laid and inspected under pressure before the upper half is cemented on. There is no chance of conduit leakage because of mismated sections. It can easily be opened up at any time to locate leaks in pipes. And it can be taken up and relaid without injury.

Many other money-saving possibilities are told in our catalog, which will be sent on request from nearest branch.

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1432

tor-ridden country. And the janitors have the ventilating engineers on their side. In one town, in another state than this, teachers tried to open the windows in their rooms, and they received anonymous letters telling them that their jobs would be in danger if they persisted."

Chicago, Ill.—Describing the tests made of the temperature maintained in the street cars of Chicago, Health Commissioner George B. Young states that "some six hundred inspections were made on surface cars and a very large number of violations were discovered, many cars having temperatures near or below 32° F., but only those cases in which the temperature was 5° or more below the legal minimum were entered for suit. There were 118 of these. One point brought out in the investigation was the directions put forth by the street car companies to maintain the required temperature. These directions are: When the temperature registers 50° F. outside no electrical heat is turned on. When the temperature is 32° to 50°, "one point" of heat is maintained; from 10° to 32°, "two points"; and when the temperature is below zero, "three points" or full load.

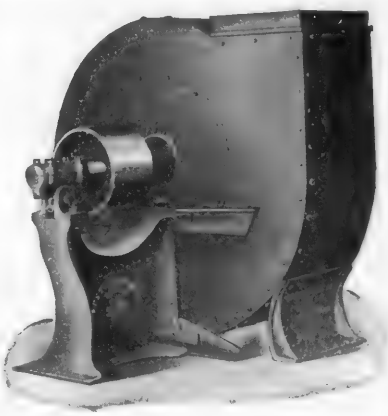
Wheeling, W. Va.—An appropriation has been made by the local board of education for an investigation of the heating and ventilating of the city's schools. Experts will be employed.

Manufacturers' Notes

Shirley Radiator and Foundry Co., Indianapolis, Ind., suffered a severe loss in the destruction of its plant by fire on January 9. The company reports that its patterns were saved as well as one of its largest warehouses, which was filled with assembled radiators. The company, which employs 160 men, is planning to rebuild on a larger scale than before, and reports that its business will not be seriously interrupted.

Crosby Steam Gauge and Valve Co., Boston, Mass., has opened a Philadelphia branch office at 425 West Lehigh avenue.

National Manufacturing and Supply Co., Minneapolis, Minn., was burned out December 31, when its three-story building, containing a stock of heating and plumbing supplies, was destroyed. The stock was valued at $80,000 and the building itself at $25,000. The company carried $60,000 insurance.



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are only one detail in the construction of Sturtevant Fans, yet they insure long life, high efficiency, and low power consumption.

In numerous tests they have been proven the equal and in some cases superior to any roller or ball-bearing for fan practice.

The friction does not increase with use, for they operate with undiminished efficiency for years.

The bearings for every Sturtevant Fan are carefully made, lined by a special process with Sturtevant White Metal (the most expensive babbitt obtainable) and carefully reamed and scraped to fit.

The fan to meet your requirements is waiting to be shipped from stock.

Our engineering organization is ready to make suggestions if you will write them fully about your requirements.

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B. F. STURTEVANT COMPANY
HYDE PARK, MASS.

860

Tuttle-Bailey Manufacturing Co., New York, manufacturers of registers, will build a Canadian factory shortly at Welland, Ont.

Chamberlin Metal Weather Strip Co., Detroit, Mich., suffered the loss of its plant in Detroit by fire, January 4, which caused a damage of $250,000. New quarters were secured within two weeks of the fire and the company states that there is no interruption in its business.

Pierce, Butler & Pierce Manufacturing Co., Syracuse, N. Y., has appointed J. B. Bernhard as general managed of manufacture at its plant in Syracuse. Mr. Bernhard was the designer of the Bernhard boiler, now known as the Progress boiler, manufactured by the Thatcher Furnace Co., with whom he was associated for several years.

Crane Company, Chicago, acting for the Crane-Hawley Company, Cincinnati, O., has purchased a site on Broadway, Cincinnati, between Biedenger alley and Ninth and Eggleston avenues, on the east, on which it will build a new warehouse.

Fowler & Wolfe Manufacturing Co., Philadelphia, Pa., manufacturers of wall radiation, has elected A. S. Moppett as secretary of the company.

H. W. Johns-Manville Co., New York, announces the removal of its branch office in Louisville, Ky., to larger quarters at 205 Paul Jones Building, with J. R. Showning in charge. Mr. Chowning has traveled in that section for some time from the Milwaukee office.

Business Changes

H. N. Francis Co., Richmond, Va., is the changed title of the Virginia Plumbing and Heating Co., of that place.

Mason City Heating and Plumbing Co., Mason City, Ia., is the new title of the Austin Plumbing, Heating and Electrical Co., of that place. Greene Bros. are the proprietors.

New Firms

Cochran-Sargent Company, St. Paul, Minn., has been organized by Moncrieff M. Cochran and Howard H. Sargent to take over the business of the United States Supply Co., jobbers of engineers', plumbers' and gas fitters' supplies, at 186-190 East Sixth street. Mr. Cochran, president of the company, has been associated with Crane & Ordway for the last seven years. Mr. Sargent will assume the duties of vice-president and treasurer. The capital of the company has been increased to provide for an extension of its business.

New Corporations

Illinois Oil, Gas Heating Co., White Hall, Ill., capital $50,000, to manufacture and deal in oil, gas and other burners, stoves, heaters, etc. Incorporators: Elinzer M. Prindle, Edwin S. White and George W. Prindle.

Murphy Plumbing Co., Jersey City, N. J., capital $25,000, to conduct a heating and ventilating and plumbing business. Incorporators: W. J. Murphy, D. G. Bergen and M. A. Sullivan, all of Jersey City.

Bottum Valve Co., Chicago, organized with offices at 162 North Dearborn street, to manufacture heat intensifiers for hot-water pressure heating systems. Among those interested are George L. Bottum and H. O. Walker.

Simpson Manufacturing Co., Homer, Mich., capital $100,000, to manufacture vacuum cleaners and internal combustion engines. Incorporators: Eugene Higgins, Herbert A. Simpson and W. J. McIlwain. A plant is under construction at Homer.

Ney Bros., Springfield, Ill., capital $15,000, to engage in heating and plumbing contracting business. Incorporators: John Ney, Jr., Oscar Ney and John Ney.

Stafford Heating and Sheet Metal Co., Conneaut, O., capital, $10,000. Incorporators: F. T. Walton and others.

Hoosier City Boiler Manufacturing Co., Marion, Ind., capital $100,000, to manufacture boilers, tanks, etc. Directors: James M. Broucher, J. I. Stephenson and Major A. Dowing.

Yankee Combination Nozzle Co., Cleveland, O., capital $10,000, to manufacture combination sprinkling and spraying nozzles, with offices at 360 Arcade. Incorporators: James H. McConkey, Francis J. French, W. L. Towle, Jr., and others.

Reuscher Manufacturing Co., Toledo, O., capital $35,000, to manufacture pipe-threading machinery. Incorporators: Charles A. Reuscher and others.

W. C. Jones Contracting Co., Washington, D. C., capital $50,000, to take over

FOR PIPE JOINTS You can't do better than use Dixon's Pipe-Joint Compound on all pipe joints— keeps all joints tight.
JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J.

the business of Darnall & Jones, heating and plumbing contractors. President, W. C. Jones; vice-president, J. Carl Darnall; secretary and treasurer, Joseph J. Devine. Offices are at 720 13th street N. W.

William Busching Supply Co., Fort Wayne, Ind., capital $20,000, to deal in heating and plumbing supplies. Incorporators: William Hockmeyer, William Busching, Paul Shoman and M. Busching.

Business Troubles

Chase & Baker Co., Boston, Mass., heating contractors, has made an assignment, for the benefit of creditors, to Edward A. Morris, of Winchester. Among the creditors are the Pierce, Buler & Pierce Manufacturin~ Co., the Davis Co., Gurney Heater Manufacturing Co. and the United States Radiator Corporation.

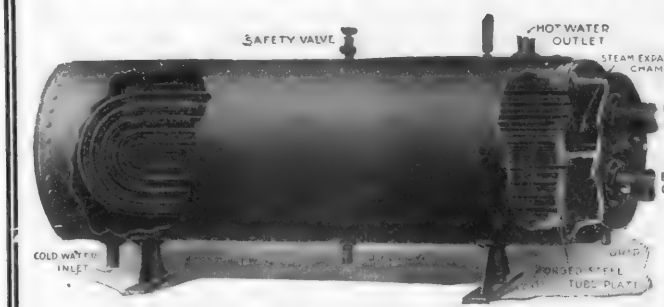
Trade Literature

Radiation for December, 1911, the interesting periodical published by the United States Radiator Corporation, has among its notable articles, "The Fuels of Other Nations," by George Ethelbert Walsh, and "Interesting Hospital Installation," by Alfred G. King, being a description of the low pressure steam plant recently installed in the Reading (Pa.) Hospital. The serial articles on "Heating Builders with Steam," "Scientific Management as Applied to the Heating Industry," and "Fuel and Draft" are continued.

J-M Sectional Conduit, a complete underground pipe covering system, is the subject of a new and exhaustive catalogue published by H. W. Johns-Manville Co., New York. In addition to a description, with illustrations, of this well-known form of conduit, the catalogue contains some interesting figures giving a comparison of the saving effected by three types of underground steam systems. Diagrams of numerous illustrations are included, showing the wide favor in which this type of pipe covering is held. A double page sectional view of a typical installation of J-M sectional underground conduit occupies the centre pages. The catalogue contains full information as to sizes and prices. Size 6 x 9 in. (Standard). Pp. 44.

Armstrong Pipe Threading Machines and Parts is a new catalogue lately issued by the Armstrong Manufacturing Co., Bridgeport, Conn., showing its unusually complete line of these tools. Each part is either lettered or numbered so that a customer can order repairs to replace broken or won out pats from

PATTERSON HOT WATER HEATERS



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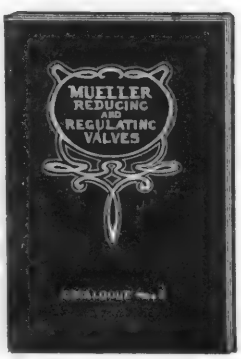
the catalogue, thus saving much time. The various pipe machines made by the company are illustrated, especial attention being called to the quality of material used in their construction, and their interchangeable parts. The No. 0 and No. 00 machines are equipped with the genuine Armstrong adjustable dies, while the No. 1, 1½ and 3 machines have bits for threading especially made for these machines. A copy of the catalogue, we understand, will be sent on request.

Power Users' Creed is the title of a booklet featuring the metal-to-metal joints of the Sturtevant ecnomizer made by the B. F. Sturtevant Co., Hyde Park, Mass. The booklet contains interesting views of installations of Sturtevant economizers, together with a lengthy list of notable installations.

B. T. U. For Estimating Steam or Water Radiation is the subject of a circular published by the B. T. U. Rule Company, Omaha, Neb. The device described in the circular is in the form of a slide rule and is ingeniously arranged for making quick estimates of contents, glass and wall and their relation to either water of steam radiation. It is made of well seasoned wood, with white celluloid facings and slides and is printed on celluloid with nickel plated glass slide and polished glass hair line. The ruler sells for $5.00.

Duplex Ventilators, designed for installation in the sashes of windows and operated by means of small electric blowers forcing the air over the radiator, are described in a new catalogue just issued by Ventilating Systems Company, 1328 Broadway, New York. The various types of units are illustrated and described while some interesting facts are presented on the effects of bad air. Size 3½ x 6 in. (Standard). Pp. 30.

Sterling Air Purifying and Cooling System, sold by Thomas & Smith, Chicago, Ill., and consisting of a portable air washer, is described in new circular matter, showing its use, in one instance, with tempering and reheating coils. The air cooler is designed for capacities running from 200 to 5,000 cu. ft. per minute. It is mounted on rubber shod wheels and is equipped with fan, motor (ranging from ½ to 5 H. P.), washing chambers and auxiliaries. The apparatus is also provided with outlet nozzles to throw air in all directions. A special chamber is incorporated in the apparatus whereby refrigerated air can be delivered by the use of ice or cooling coils. Tests have shown that



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during summer torrid weather fresh air taken into the washer at 93° may be cooled to 76° F. and when using city service water at 72° F.

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B. Frank Drake & Son, Athens, N. Y., heating People's Coöperative Hospital at Sayre, N. Y.

David Ahern & Son, Fond du Lac, Wis., steam heating Lincoln School at that place, for $2,537.

Jesse G. Bard, Kalamazoo, Mich., heating new Y. M. C. A. building at Kalamazoo, for $3,000.

L. J. Mueller Furnace Co., Milwaukee, Wis., heating new $65,000 Second Ward School Building in that city; the plumbing contract went to Polacheck & Johnson, Milwaukee.

John G. Sutton Co., San Francisco, Cal., heating, power work, ventilating and electric wiring for St. Luke's Hospital in that city. The work will cost $41,000. The plumbing contract went to J. E. O'Mara at his bid of $29,000.

Lennig Engineering Co., San Francisco, Cal., steam heating seven-story hotel building at Monroe and Bush streets, Edward Beck, owner, for $2,249.

Abrahamson & De Gear, San Francisco, Cal., heating and ventilating Girls' High School at that place, for $29,973. The plumbing contract went to J. Looney Co., at its bid of $13,769.

Columbus Heating and Ventilating Co., Columbus, O., heating and ventilating Robinson School Building at Akron, for $4,655.

Samuel A. Esswein Plumbing and Heating Co., Columbus, O., was low bidder, at $110,248, for the mechanical equipment of the Lima State Hospital at Lima. Fitzpatrick & Hoepfner bid $112,248. The contract includes boilers, piping and heating systems.

Business Chances

Washingon, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until February 28, 1912, for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and interior fixtures for the United States post office at Elwood Ind.

Until February 29, 1912, for the construction, complete (same as above), for the Unied States post office at La Salle, Ill.

Until March 1, 1912, for the construction, complete (same as above), for the United States post office at Olympia, Wash.

Humidity Control in Manufacture of Phonograph Records

Hardly a week passes but that a new industrial use for air conditioning apparatus is found. Two recent installations for unusual purposes are those made in the plant of the Thomas A. Edison Company, Orange, N. J.

The first installation was made in the laboratory, where the dark room, wash room, dry room and printing room are located. An even cool temperature of dry air was desired with a complete air change every five minutes; 4500 cu. ft. of air were blown into the building each minute by means of a steel plate "Buffalo" blower. The air was passed through a Carrier dehumidifying apparatus equipped with the Carrier automatic dew point control. An even temperature and low humidity will be obtained the year round.

About a month later the second and larger installation was ordered by the same company to take care of the severer conditions to be encountered in their record room. In the manufacture of phonograph records it is essential for best results that an even, cool, dry air be present all seasons of the year, so that fluctuations and variations in drying and resulting inferior brittle records be done away with. The phonograph people wanted to keep the temperature of their rooms below 75° F. on the hottest summer days. This installation will do this, and, furthermore, the automatic dew point control will regulate the temperature at from 70° to 75° F., and at a low percentage of humidity, whether on the coldest, driest day of winter, on a wet, rainy day of spring, or a summer scorcher.

Similar applications are being successfully used in the manufacture of photographers' materials, gelatine and many other articles, which at some stage of manufacture are injured by hot, humid weather.

New Books

Elementary Science Applied to Sanitation and Plumbers' Work, second edition, by A. Herring-Shaw, associate of the Royal Sanitary Institute and chief assistant in the Municipal and Sanitary Engineering Department, School of Technology, Manchester, Eng., has been published in America by D. Van Nostrand Co., New York. The book is especially designed for students and includes an exhaustive series of questions and answers in the mensuration section. The general subjects include elementary science, arithmetic and mensuration, physics and chemistry. A special chapter is devoted to heating and ventilation, in which the principles are clearly stated, with numerous typical examples worked

out for the benefit of the reader. Another chapter takes up the transmission of heat and covers natural and mechanical ventilation, conduction and convection of liquids and gases, and humidity. Throughout the book the subjects are well grouped and the text is marked with a clearness of style that makes the volume an exceeding readable and useful treatise. Its value is further enhanced by a liberal use of illustrations of instruments and devices, together with diagrams illustrating the propositions given. A full index makes it easy to locate any given topic. Size 5½x9 inches, 264 pages. Price $2.00.

Doylair Smokeless Furnace

A type of furnace designed to eliminate smoke is known as the Doylair Smokeless System, and is illustrated herewith. The Doylair apparatus is designed and built for warm air furnaces,

BOOKS ON HEATING AND VENTILATION

Mechanical Equipment of Federal Buildings Under Control of the Treasury Department. By Nelson S. Thompson, chief mechanical and electrical engineer, office of the supervising architect. Second edition, revised and enlarged. Contains the basic data used in the design of the mechanical and electrical equipment of Federal buildings under the control of the Treasury Department. Also contains data for approximating the cost of the various parts of the work. The book takes in heating and ventilation, plumbing, stationary and portable vacuum cleaning plants, engines and generators, motors and controlling apparatus, forced systems of hot water heating, commercial practice in factory heating, etc., and other valuable data. Cloth, $2.00.

Heating and Ventilating Buildings, a standard manual for heating engineers and architects. By Prof. R. C. Carpenter. Fifth edition, largely rewritten. 577 pages. 277 Ills., 8vo. cloth. $4.00.

Baldwin on Heating; or Steam Heating for Buildings. By William J. Baldwin. Fifteenth edition. Revised and enlarged. 391 pages. 131 figures. Size, 5x7½ in. Contains descriptions of steam heating apparatus for warming and ventilating large buildings and private houses, with remarks and tables. Cloth, $2.50.

Handbook for Heating and Ventilating Engineers. By Prof. James D. Hoffman and Benjamin F. Raber. The latest book on this subject. Unusually comprehensive. 320 pages, with 45-page appendix. Size 4½x6¾ in., bound in flexible leather. Price. $3.50.

Questions and Answers on the Practice and Theory of Steam and Hot-Water Heating. By R. M. Starbuck. Illustrated. $1.00.

Ventilation of Buildings. By William G. Snow and Thomas Nolan. 83 pages. Pocket size. Contains a statement of the general principles of ventilation and of their application to different kinds of buildings. Boards, 50c

Steam Heating and Ventilation. By Wm. S. Monroe. Containing formulas and data valuable in the designing of heating and ventilating plants. Price, $2.00.

Air-Conditioning. By G. B. Wilson. Being a short treatise on the humidification, ventilation, cooling and the hygiene of textile factories—especially with relation to those in the U. S. A. With figures. 12mo. Illustrated. 143 pages. Price, $1.20.

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Light, Heat and Power in Buildings. By Alton D Adams, M. E. The purpose of this volume is to present in compact form the main facts on which selection of the sources of light, heat and power in buildings should be based. The problem is to determine the kind of equipment that will yield the service required at the least cost. 12mo. Cloth, $1.00.

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Dean's System of Greenhouse Heating, by steam or hot water, with formulas for obtaining different temperatures, by Mark Dean. Price, $2.00.

Power, Heating and Ventilation. By Charles L. Hubbard, B.S., M.E. A treatise for designing and constructing engineers and architects. The whole subject of heating is covered, including the heating of large institutions with central plants. Space is also devoted to electrical matters connected with steam plants. 647 pages. Price, $5.00 (three volumes in one).

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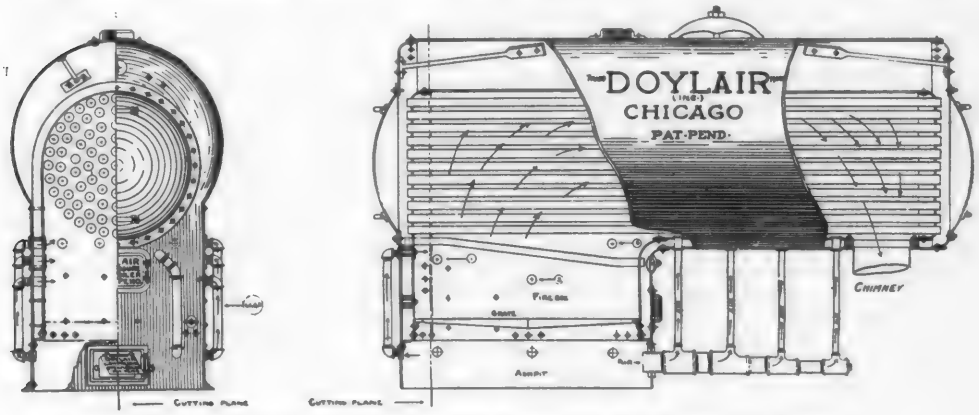

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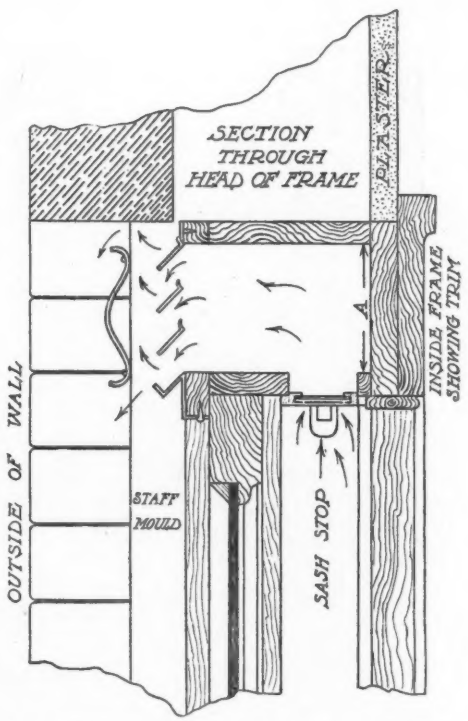

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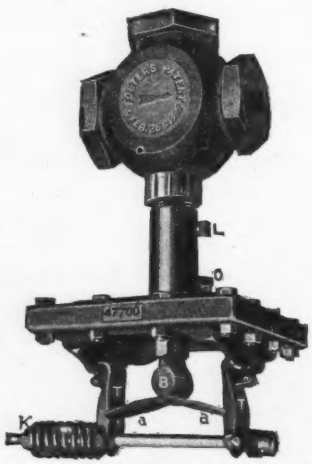

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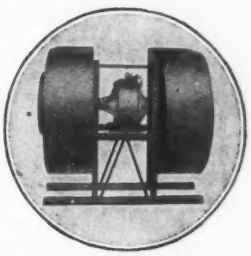

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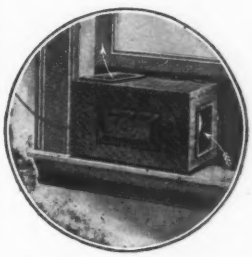

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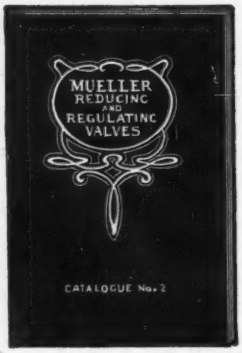

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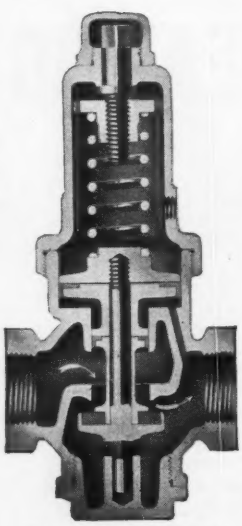

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